

# BULLETIN

OF

THE NEW YORK STATE COLLEGE OF FORESTRY

AT SYRACUSE UNIVERSITY

FRANKLIN MOON, *Dean*

## Roosevelt Wild Life Bulletin

VOLUME 5

NUMBER 1

OF THE

Roosevelt Wild Life Forest Experiment Station



WILD LIFE AND FOREST SURVEY OF  
S. W. CATTARAUGUS CO., N. Y.

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† Including only those who have made field investigations and whose reports are now in preparation.

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Fig. 1. Lower Bone Run, looking east toward the mountains of the Allegany State Park in the distance.

# A PRELIMINARY WILD LIFE AND FOREST SURVEY OF SOUTHWESTERN CATTARAUGUS COUNTY, NEW YORK

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## INTRODUCTION: GENERAL DESCRIPTION OF THE TRACT AND ITS WILD LIFE

New York, like many other States, has a "rural problem," namely, that of utilizing in some way a great deal of land which has proven unsuitable for agriculture. Many solutions have been suggested, and, while this bulletin is not an attempt to solve the "rural problem," yet it has a direct bearing upon it.

In the extreme southwestern corner of Cattaraugus County, lies the township of South Valley, a township of considerable size, but with a small population. For some years before and after the Civil War, many areas were cleared, chiefly by Irish immigrants who saw in the valley-bottoms of the township the possibility of making a better living than they could on the small, impoverished fields of the "Old Country." They established prosperous farms which they worked during the summer months, and during the winters engaged in lumbering on the uncleared lands. The farming methods, however, were such that the soil was soon deprived of its fertility. While in all probability it looked better to the settlers than that upon which they had been reared, there nevertheless was a limit to the ill use it could stand. The inevitable results followed: The next generation became discouraged and moved away to try their fortunes in other and more favorable localities, with the result that the territory now lies robbed of its fertility and stripped of its timber, waiting for the far-off time when the forests shall have grown to merchantable size, when the lumberman shall have come and gone again, leaving behind him a situation even worse than before. Many farms now lie deserted. In order to indicate graphically the extent to which the population in this area has declined, a portion of the U. S. Geological Survey Topographic sheet of this area has been adapted for the purpose as shown by Map 1. The valley in the area in question, shown on the accompanying sketch map and named "South Fork of Sawmill Run" on the survey sheets, but formerly called "Brennan Run" by the inhabitants, is but little different from most other valleys in the township. By the hard process of "cut-and-try" the section has demonstrated its unfitness for agriculture, and the monuments to the attempt to wrest a living from the hills with the plow and the scythe are now apparent to the passerby in weatherbeaten, abandoned farm houses or their ruins.

During the summer of 1926 the Roosevelt Wild Life Forest Experiment Station conducted a wild life and forest survey of an

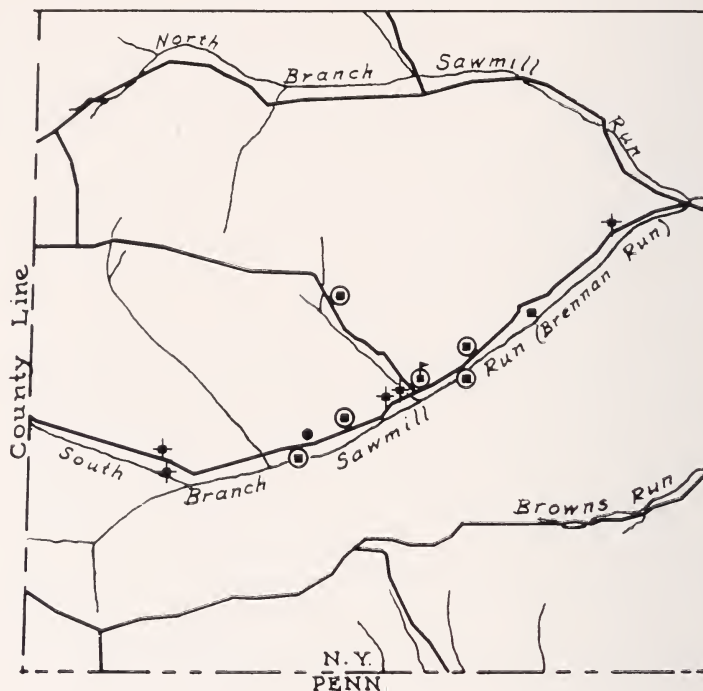
area of about 36,000 acres which included parts of the townships of South Valley, Elko, and Randolph (the exact extent is shown on Map 2) in an attempt to learn its possibilities if it were to be turned into a game and forest tract, in which game should be the major consideration and forestry and forest practice should be only of such kind as to promote to the utmost the production, increase and maintenance of the desired kinds of game. The problem of turning this particular tract into a game preserve is, of course, purely theoretical. The tract is, however, a fairly representative sample of other more or less abandoned areas throughout the State which have not demonstrated any satisfactory possibilities as agricultural land, and it may, therefore, serve simply as an example of one method of treating such areas.

The writer was given the task of making the investigation of the bird and mammal life as well as the forestry aspects of the survey, and the results of the field work, and of subsequent suggestions received, are embodied in this report. The field work had for its objective the securing of a description of the tract itself, particularly regarding conditions affecting wild life, as well as the present status of the various species of mammals and birds of the area. Attention was not confined to the game species alone, but insectivorous and other birds as well as fur-bearing and non-game mammals were also studied, for in a tract which might (supposedly) be considered for acquisition as a game preserve, all wild life is of interest, even if not of direct bearing upon the game, because of the many and various interrelations of wild life generally.

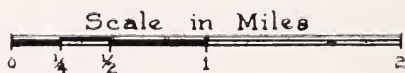
It will probably be of help, in reading the descriptive matter, to follow quite closely the maps of the area, a number of which are provided. In this way a better idea of the tract will be gained than can be had from the descriptions alone.

To Dr. Charles E. Johnson, Director of the Station, I wish to acknowledge my indebtedness for his wholehearted cooperation generally, for many ideas regarding methods in the carrying on of the field work and for other conceptions embodied in this report. I also wish especially to thank Mr. and Mrs. L. H. Hansen, Mr. and Mrs. Harry Moore, Mr. and Mrs. Robert Beatty of Onoville and Mrs. Iva Mighells of Randolph for their hospitality and many acts of generosity not ordinarily included under the item of "room and board," which did much to aid me in my work. Lastly, I am indebted to all those whose names appear in the following pages as having given me information, as well as to many others, too numerous to mention, who have been of assistance in some way while the work was in progress.





# SKETCH SHOWING ROADS VICINITY OF SOUTH BRANCH SAWMILL RUN



## LEGEND

- - House
- ★ - House Deserted
- ⊙ - House Disappeared
- ⊕ - School Disappeared
- - Hunting Camp

Adapted from U.S.G.S. Map

Map 1. Sketch showing roads in the vicinity of South Branch Sawmill Run and status of buildings along the latter.

The area selected for study lies in the southwestern part of New York State, in the southwest corner of Cattaraugus County. Only the narrow Allegany Indian Reservation separates it from the Allegany State Park to the east, and the south boundary of the tract coincides with the New York-Pennsylvania state line. It is therefore about 75 miles south of Buffalo and is easily accessible from most directions. A few miles to the northeast lies the city of Salamanca, of about 9,000 people; this is a center for three railways and provides a convenient point from which to visit the tract, either by automobile, using the highway along the Allegheny River, or by taking the Pennsylvania Railroad to Onoville, a small village on the east side of the area and from which State Line, Sawmill, Bone and Pierce Runs may be visited. West of Salamanca and only a short distance north of the tract is the town of Randolph. This has a population of about 1,500 and provides railroad communications by means of the Erie. Randolph is a good point of departure for places in the northern part of the tract. About 10 miles west of the western boundary, which is the Cattaraugus-Chautauqua County line, lies Jamestown, a city of 39,000 inhabitants. From here, an automobile or other conveyance may be used for reaching the tract, which may be entered at three different points, according to the route taken. The roads are fairly good and bring one into Sawmill Run, Bone Run or Mud Creek, and if desirable a fourth way may be added, going through the little hamlet of Ivory and reaching a point on the county line about midway between Bone Run and Mud Creek. Besides these nearby points in New York State, there is also Warren, Pennsylvania, a city of 15,000, about 15 miles south of the tract. Once within the boundaries of the tract, the roads provide easy communication with almost all parts. The roads shown by solid lines on the map as primary highways are all suitable for automobile travel, with the exception of the Phillips Brook road, which at the time the survey was made was still open and passable with teams but was unsafe for motor vehicles.

For purposes of description, the tract is readily divided into two sections, termed for convenience Divisions I and II, the basis of which is the separation of the primarily agricultural from the non-agricultural lands. Present use is only the most obvious result of the underlying factors, such as topography, drainage, soil, and so forth, and for simplicity may be made the criterion for division. It is not meant that this should be taken as an exact separation, for it is but natural that in making such sweeping generalities some conflicts and discrepancies should occur. However, the southern part of the

tract (called Division I) is predominantly forest land. Here the land has had a chance to demonstrate what it was worth agriculturally, and a trip along the roads, with their overgrown fields and abandoned houses, will show that it has been found wanting. The northern part of the tract (Division II) contains much good farming land, is much less rugged, and presents a problem differing radically in many respects from that of the southern section. The dividing line will run from the Corbett Hill School along the road west to Corner "2035" north of Pine Hill, then west to Vollentine church and on to the point where the Mud Creek road crosses the Cattaraugus-Chautauqua County line. South of the line the tract consists mostly of forests, with a comparatively small acreage of land once tilled but now used for pasture, though some of it is reverting to woodland because of reduction of grazing. To the north lies the farming country of Vollentine and Bowen and the neighborhood of Corbett Hill, where most of the land is either cultivated or consists of hay land, and where the wooded areas comprise merely small isolated woodlots, reverted pasture land and sugar maple groves. The photographs represented in figures 1 and 2 will perhaps give a better idea of the nature of the country than will more detailed description.

As mentioned above, the topography of the two sections of the tract was one of their most marked points of difference. Division I is dissected by streams flowing either east or southeast into the Allegheny River, which have left a series of more or less parallel ridges, some of which rise to a height of almost a thousand feet above the valley-bottoms. In the lower courses of the streams the slopes continue at an even grade from the valleys to the tops of the ridges, but become shorter and steeper in the upper courses where the valleys are much narrower; the comparison is shown by figures 1 and 3. Usually the streams are small during most of the year, but may vary greatly in size, depending upon the season. I was informed by residents of the tract that Sawmill Run, within their experience had never entirely ceased to flow even during the driest season; that Browns and Pierce Runs rarely have water in their lower courses during dry seasons; and that Bone Run is frequently dry in summer. Mr. Harry Moore, of Pierce Run, declared that he had seen this stream rise four feet in about five minutes, and while such freshets are rare it is not unusual for the brooks to rise to such a level as a result of several days of steady, hard rain. With the cutting off of the forests the tendency has been for the streams to become not only smaller in size, but also subject to much more frequent fluctuations.



Fig. 2. View south from a point near the triangulation station north of Carr Corners, showing the open rolling condition of the foreground (Division II) and the rugged forested ridges (Division I) in the distance.





Fig. 3. View northward in the North Branch of Bone Run.



Fig. 4. Pine Hill from the south.



The northern part or Division II of the tract lacks the broken characteristics of the southern part, and though distinctly rolling is without definite ridges. Drainage is toward the north, with the exception of the basin northeast of Pine Hill, where the Little Conewango Creek flows to the east. All of the streams are small though subject to much variation, as the open character of the country would indicate. Very little of this Division is too steep for cultivation; in fact most of the entire open area is suitable for that purpose. Much of this Division is more valuable for the raising of farm crops than for any other use, and stands in marked contrast to the bulk of Division I. There are, however, a few abandoned farms here also, especially near Pine Hill, the south slope of which is shown in figure 4.

The soil is a clay loam and is moderately deep, except on the tops of the ridges where in places a very few outcrops of rock occur. Ledges are absent, even on the steepest slopes, although the steep south side of the valley of the Little Conewango approaches a ledge condition. Land values in this section depend chiefly upon the capacity of the soil to grow agricultural crops, which varies considerably. The land in Division II is, as a rule, rolling and adaptable to the use of farm machinery, the exception being the small fields to the south which are in many places too hilly and too steep. Furthermore, much of the land here, because of its elevation and steepness, is too thoroughly drained to be good for agriculture; but few spots are so deficient in moisture as to render the tree growth of noticeably poor quality. On the other hand, the amount of poorly drained land probably does not run over twenty acres as a rough estimate for the entire tract. Most of the alluvial valley bottoms of Division I, if not impoverished by poor care in the past, have excellent soil for the growing of agricultural crops, but it is believed that the slopes are better adapted for forests.

As stated previously, the present condition of agricultural land in Divisions I and II varies greatly. That in the latter division is grouped under a relatively small number of owners, making large units, and this tends towards high class up-to-date agriculture, the cultivated land being utilized according to modern ideas of conservation of soil fertility. The hay land is as a rule in better condition in its freedom from weeds, such as white daisy and paint-brush, than are the fields of South Valley. The chief crops grown are hay and grain, the latter being most commonly corn, oats, buckwheat and wheat. This industry is combined with dairying which, however, plays a minor part. The pastures are in poorer condition relatively

than the fields, most of them being more or less overgrown with brush and trees. Even where fully pastured, hardwoods and hemlock occupy much of the land, utilizing space but yielding usually only cordwood and lowering the value of the pasturage through the reduction of the sugar content of the heavily shaded grass. A pasture of this type is shown in figure 5. On the whole, however, the farms are modern and progressive.

Division I, on the other hand, is quite different. With the exception of a very few small but well-managed farms devoted to the raising of grain, hay and general crops, as well as to dairying, the agricultural land itself, quite small in proportion to the total area, is either in poor producing condition or else is abandoned entirely. Most of the farms are too small to be operated profitably and the narrowness of the valleys limits the alluvial land of each to a small acreage. Practically all the available land is therefore on the ridges, where the great care necessary to prevent the loss of soil fertility, and its becoming sour, has in most cases not been taken. Most of the fields have been "run to death," as the visitor to the tract during the summer and especially the fall months can easily see. At this season when the fields have been grazed or mowed, the bright green of the fresh grass denotes that fact; uncut hay, on the other hand, is bleached to a light straw-color. The visitor, if stationed on a point of vantage which will allow him to observe a considerable slope of open ridge side, will see that a very great proportion of the land is lying idle and is in many cases being covered with such light seeded tree species as large-toothed aspen (*Populus grandidentata*), trembling aspen (*P. tremuloides*), blue beech (*Carpinus caroliniana*), the maples (chiefly *Acer rubrum*, but also *A. saccharum*), as well as bird-distributed kinds such as the thorn apples (*Crataegus*) and the cherries (*Prunus*)—worthless from the viewpoint of the farmer and lumberman but fortunately able to prevent erosion and provide food and shelter for game birds and mammals. This old field type, as it is termed in forestry, is only a step in the process of reversion to forest, being succeeded, if fire is kept out, by a growth of more shade tolerant and valuable commercial species which spring up under the protection of the earlier and faster growing kinds and replace the earlier type as it passes maturity. Complete reversion, the first step in which is illustrated in figure 6, is, however, slow at best, and it will be many decades before the present old-field type of South Valley is replaced by a valuable commercial stand, even if grazing be entirely excluded. An attempt has been made to show on Map 2, in yellow colors, the more appreciable areas of this type, which can be

called neither "open field" nor forest. It must be kept in mind that many, possibly hundreds, of small patches of old field type along the edges and in the corners of open fields beginning to revert to hardwoods, have not been shown; they have been thrown into either of the other two groupings accordingly as seemed justifiable on the basis of character and density of the vegetation.

Prior to the settlement of this section it was practically covered, from the hill tops to the stream-bottoms, with a dense growth of white pine, with here and there clumps of hemlock. The tract in question was very likely essentially the same in character as any similar area in the white pine-hemlock type which once covered much of the Northeastern United States. Once started, the process of lumbering progressed very rapidly, and though it is only a matter of a century since the timber of the tract was practically virgin softwoods, the only traces now remaining are scattered pines and occasional clumps of hemlock, the latter usually along the streams. The period during which the original forest was lumbered was a prosperous one for the communities in and immediately surrounding the tract, and the income from the sale of forest products seemed to be endless, although the clearing of the land encouraged the establishment of farms. The process of lumbering could not, of course, continue forever, but during its height the country was dotted with mills both large and small; the larger depending on steam for power since the flow of the majority of the streams was insufficient for the development of water power during most months of the year. A large number of families located themselves in the neighborhood of the mills in order to be near the source of employment. Prosperity was general and business "boomed."

The sad part of the history is, however, the fact that it must sooner or later come to an end. After the merchantable timber had been taken off, the mills moved away, and for the past twenty-five years only occasional cuttings of timber have been made, chiefly by operators of small portable mills. The end of employment meant that those formerly depending upon the lumber industry for their livelihood now either moved away or went into agriculture, and the general course of events in the latter case has already been sketched.

The present forest areas of the tract constitute about 70 per cent of the total acreage. The distribution of these areas (in green) is shown on Map 3. The topography has been described under the general description of the tract, and it is sufficient here to say that in general the slopes are nowhere too steep for forest growth, although in places they are sufficiently precipitous for destruction by

erosion if stripped of vegetation. They present no especial difficulties for logging.

The present forest, composed almost entirely of hardwoods, is made up of the following species listed approximately in the order of their abundance: sugar maple (*Acer saccharum*), beech (*Fagus grandifolia*), red oak (*Quercus borealis*), basswood (*Tilia americana*), Chestnut (*Castanea dentata*), black oak (*Quercus velutina*), white ash (*Fraxinus americana*), black birch (*Betula lenta*), pignut hickory (*Carya glabra*), white oak (*Quercus alba*), large-toothed aspen (*Populus grandidentata*), trembling aspen (*Populus tremuloides*), black cherry (*Prunus serotina*), pin cherry (*Prunus pennsylvanica*), yellow birch (*Betula lutea*), hemlock (*Tsuga canadensis*), shag-bark hickory (*Carya ovata*), cucumber tree (*Magnolia acuminata*), chestnut oak (*Quercus montana*), tulip tree (*Liriodendron tulipifera*), white pine (*Pinus Strobus*), bitternut (*Carya cordiformis*), mocker nut (*Carya alba*), and butternut (*Juglans cinerea*).

Assuming a continuance of present conditions into the future, it is probable that the present forest area will see little change for perhaps two decades. Only two relatively small-sized lumbering "jobs" were located in the tract during the summer of 1926, due to the fact that practically all of the best merchantable timber has already been removed. The usual small areas will be cut-over for firewood to meet individual family needs; on the other hand there will be some forest area added through natural reproduction taking place in areas of old-field type. With increasing closeness of utilization, however, it is certain that, assuming the tract to remain in the hands of private owners, the present timber will not reach a large size before going under the ax. Disregarding entirely the forestry side of the question, the general effect upon most game animals would then be more beneficial than harmful. The smaller game animals, both mammals and birds, prefer generally a brush and young growth habitat because they find here better cover and usually more food than in mature stands. Of course the larger mammals such as bear and deer prefer larger growth, at least high enough to give them a feeling of security; but provided cutting is not too general and concentrated within a short period of time, there is little or no danger of depleting the breeding stock of game through destruction of habitats. In the tract in question it is very improbable that more forest land will be cleared and devoted to agricultural uses; the tendency is rather in the opposite direction at present, and the reversion is likely to be allowed to continue well into the future. Therefore I do not feel that the game is due to be affected through any probable future



destruction or adverse change of the forest area. Theoretical management of the timberlands will be discussed later, the foregoing being possibly a rash attempt to interpret the future under practical conditions.

The purpose of the survey was principally to gain as much information as possible regarding the wild life of the tract, the present conditions affecting it and the possibilities of the future. Only a very general reference to the results obtained will be made here, the more detailed account appearing later in this paper.

Insectivorous birds were found to be abundant, and their considerable variety is indicated beyond in the section devoted to that subject. As in other sections of the country, the game birds and mammals have been badly reduced in numbers, but the comparative inaccessibility and wildness of most of the tract has been responsible for much unintentional conservation. The ruffed grouse was found in fair numbers, but the woodcock and that introduced game bird, the pheasant, were very scarce and found only in certain localities. Of the mammals, deer were also at a low stage numerically, but prospects for their increase are excellent and they could, probably, within a decade be increased sufficiently to provide excellent sport. Bear apparently are on the increase. But the situation regarding the other species of mammals generally classed as game is quite different. The gray squirrel is rare, due probably to a periodic fluctuation from which it will shortly recover; the snowshoe rabbit is fairly abundant and seems to be at least holding its own. The fox squirrel is rare, if indeed it exists at all on the tract. Of the fur-bearers not generally listed as important enemies of the game birds and mammals already mentioned, the raccoon would appear, from the number of tracks and other signs, to be actually abundant in the wooded parts of the tract. The muskrat unfortunately is scarce except in one locality. Skunks are common. The commonly recognized predatory species include the red fox, which is numerous and appears to be increasing; the weasel, which is abundant; and the mink, which, due to trapping, is rare. Hawks are relatively numerous, and in the northern part of the tract a considerable number of the more destructive species, the sharp-shinned and Cooper's hawks, are present. The subject of control of enemies of wild life is one which will be taken up more fully later in the report.

Without entering into the complexities of the ecological relations and interrelations of the various species of animals, a general statement on the desirability and possibility of increasing the wild life of the tract may be made. Certain species are of course more or less



undesirable from certain points of view though they may have certain qualities which commend them. At present the red squirrel is shot as a nuisance and for its reputation of robbing bird nests of their eggs. The porcupine in this tract seems to cause very little damage to forest trees, but it has been known to become troublesome in certain other sections of the country, and if allowed to increase without restriction in the tract, might possibly become a pest here also. The mink is a valuable fur-bearer, but may possibly at times do more damage to wild life in a limited area than its skin is worth; it may become especially undesirable on a trout stream or in a true game sanctuary. These illustrations will serve to indicate that some species may not be wanted in larger numbers than will serve to maintain the "balance of nature." However, as previously stated, the investigation was undertaken to determine the possibilities of the Cattaraugus tract as a game refuge. To that end certain species valuable for sport or other purposes ought to be increased, but some will need to be controlled. The problem, which is naturally of rather complex nature, should include a consideration of the amount of game already on hand (i. e., the breeding stock); the amount of available food for the species now on the tract, or possible to introduce and maintain under proper methods; and the subject of planting extra stock and of protecting the game, when once established, from natural enemies and from man. Also we cannot disregard the problem of the effect of a greatly increased game population upon the agriculture of the surrounding territory, which unless carefully regulated, is likely to prove serious.

There is also the problem at the same time of creating on the tract a demonstration forest, in order not only to utilize the land but to return a profit from it; and also to show what may be done with similar lands throughout the State. It must be kept in mind that game is to be the primary object, and that forestry is to be carried on in such a manner only as to assist the production, increase and maintenance of the wild life. However, the writer is of the opinion that forestry can be practiced in such a modified manner that it will easily harmonize with the interests of the sportsman. Ordinarily, purely commercial forestry creates many unfavorable conditions for game. The customary method of planting in this country—generally close spacing with conifers—provides cover but no food for most game animals. Clear-cutting of large areas is likewise detrimental to practically all species, because their environment is thus altered and they cannot find suitable habitats elsewhere without a considerable migration. Later on we shall consider the problem of harmonizing the interests of forestry practice and game propagation.

## AREAL CLASSIFICATION AND DESCRIPTION OF THE TRACT

For describing the forest of the tract, the wooded sections (colored green on Map 2) have been divided into areas convenient for the purpose. For the purposes primarily of a *wild life* survey, it was not believed that great detail of description would be necessary or desirable. The forest, however, is the foraging ground, refuge and permanent home of many species of wild life, and, since the *form* of the forest, or, as it is called in forestry, the *type*, has considerable significance for these essential requirements of life, a description is necessary but will be made as brief as possible. This description, it is realized, may also be found of value at some future time should a knowledge of past conditions then be desired.

In a tract of this size, consisting as it does of about 56.3 square miles, or 36,000 acres, some of the difficulties of adequately mapping the types can easily be imagined. The only basic map available at the time of the survey was the topographic sheet of the U. S. Geological Survey, on a scale of 1:62,500. Now, under the definition, a forest type can include in one area only a stand of trees which are of the same age or range of ages and composition as to species. A small patch of perhaps several acres or less, caused by cutting into a mature stand (itself one type) for a winter's supply of firewood, would for instance, under a strict observance of the rules of type-mapping, necessarily be classed as a separate type. Furthermore two acres on the ground would, if accurately represented on the map, occupy approximately only  $1/325$ th of a square inch—obviously too small for practical mapping. Therefore, from the beginning of the survey the rule was followed that only stands of large enough area to be readily mapped were recognized while smaller divisions were either included within the boundaries of the adjoining type or, in some cases where the difference between the two types was especially striking, were referred to in a note under the detailed description. The type-map should not, therefore, be taken literally as an exact representation of the forests of the tract, but it will, it is hoped, serve the purpose for which it was intended: to give the reader a systematic idea of the forested areas.

Common or non-scientific names of the species are used throughout, as it is felt that in a popular description scientific names would be out of place. However, at the end of the detailed description of habitats will be found a list of the trees, shrubs and other plants

most often mentioned in the descriptions, with their Latin names. Effort has also been made to list the species, in each habitat description, in the order of abundance in which they were found to occur. In reading the descriptions of the many areas constant reference to the map is necessary, where each area is numbered to correspond with its number in the text. The areas are numbered beginning at the southeast corner of the tract, and the attempt has been made to run the numbering in the order in which the areas would be visited in going over the actual ground, following the natural drainage systems. For instance, the south side of the Browns Run road has been described first, starting at the Indian Reservation and proceeding in as systematic a manner as possible to the west edge of the tract, which corresponds with the county line. The numbering then proceeds north to the other side of the road, still within the drainage area of Browns Run, then doubles back. By dividing the part of the tract called Division I into these drainage areas it is hoped that difficulties of procedure will be lessened.

The following data have been compiled with the sole objective of showing in a general way the kind, quality, and perhaps amount of material which will at maturity be transformed into forest products, without, at the same time, pretending to the accuracy which is a part of a forest survey. I have simply tried to give a very brief picture of the various stands, with perhaps a word on the recent past treatment where this has had particularly noticeable results on the present stand, and in a few cases, a note on the probable future of an especially promising, or unpromising, piece of woodland.

**Division I: Areas principally Forested.** *Subdivision I (South Boundary of Tract North to Browns Run. Areas 1-24 inclusive).*  
Area 1: A typical stream-bordering and valley-bottom type of forest; chiefly hemlock, with a scattering of such lowland species as yellow birch, black birch and soft maple.

Area 2: A young and relatively worthless stand of trembling aspen and other lightseeded species—former old field type, now completely closed and very dense in places.

Area 3: A mixed stand of oak, maple and chestnut, with a sprinkling of beech. Openings are numerous, indicating probably that selection cuttings have been the rule here.

Area 4: Cut over at various times between 5 and 15 years ago, most recently in the western part. Scattered hemlocks were left, and these now stand above a dense growth of hard and soft maples, black birch, ash, trembling aspen and red and white oaks.

Area 7: Scattered maple and beech, at least 50 years of age, with stands of over 20 year old hard maple, beech, ash and basswood.

Area 8: All-aged red oak and maple occupy the site, with a hemlock understory.

Area 9: Old field, almost fully stocked with a great variety of hardwoods and a little white pine.

Area 10: Like the preceding, but the cover is complete except in a few places, and the type becomes hardwoods, aged 11 to 20 years. Oak, chestnut, aspen, hard and soft maples and cherry are the most prominent species.

Area 11: Varies in its classification between old field and 11 to 20 year old hardwoods. The principal species is poplar.

Area 12: A stand of 41 to 50 year old oak and chestnut.

Area 13: Burned over in 1923. Most of this section is now a tangle of maples, black birch, and berry bushes, with some 31 to 40 year old beech and maple left from the previous stand.

Area 14: The main stand is 21 to 30 year old maple, black birch, oak, and a little chestnut and cherry; the understory is beech and hemlock.

Area 15: A 0.4 stocked old field.

Area 16: A light surface fire occurred here two years ago, which killed all undergrowth but apparently did little damage to the large trees. Hard maple is now sprouting vigorously among the damaged undercover. The composition is the same as that of area 26 bordering on the north.

Area 17: A stand of 11 to 20 year old hard maple, black birch, cherry and ash; open and with some grassy clearings.

Area 18: 11 to 20 year old maple; contains also some black birch and cherry.

Area 19: A narrow strip of 41 to 50 year old beech, with a scant mixture of maple. There is a dense undergrowth of 10 year old beech.

Area 20: Old field, about 0.1 stocked, the south edge being a chestnut-oak type of greater density.

Area 21: The same as 22, except that hard maple here replaces the oak. Chestnut, both dead and living, is a prominent feature.

Area 22: An 11 to 20 year old oak stand, with some aspen and cucumber trees; very dense'y stocked.

Area 23: Clear cut, except for scattered hemlocks, 4 or 5 years ago. The reproduction consists of hard maple coppice, but black birch seedlings are very numerous.

Area 24: Hard maple coppice, aged 11 to 20 years, dense and with very little undergrowth; hemlock occurs on the upper slope.

*Subdivision 2 (Sawmill Run and North and South Branches. Areas 25-97 inclusive).*—Area 25: 21 to 30 year old hard maple, with a little beech. Recent selection cuttings have made a few openings.

Area 26: An all-aged stand, except for a deficiency in the 11 to 30 year age classes. There is some hemlock in the northern part, besides hard maple, beech, basswood and ash. Hard maple reproduction is abundant.

Area 27: A very dense growth of 11 to 20 year old hard maple.

Area 28: Formerly old field type, now fully stocked with trembling aspen, soft maple, hornbeam and basswood.

Area 29: The last previous cutting, 10 years ago, left isolated beeches which now tower above a dense growth of hard maple and an occasional cherry.

Area 30: A fine 31 to 40 year old stand of beech and maple; a small area near the center about 80 to 100 years of age. Reproduction of hard maple is very dense.

Area 31: A 0.3 stocked old field.

Area 32: An all-aged stand of beech, hard maple, ash, basswood and hemlock. All the merchantable hemlock was cut during 1926.

Area 33: Same type as the preceding; all merchantable hardwoods and softwoods recently cut off, the cutting to be extended into area 32 in the near future.

Area 34: A 10 year old hard maple growth, with a little beech in mixture with numerous scattered large trees of both species, left over from the previous stand.

Area 35: Clear cut 5 years ago. Reproduction of maple, beech and black birch is very dense.

Area 36: Composition similar to that of the preceding, but the age-class is 11 to 20 years.

Area 37: An all-aged stand composed of maple, beech, basswood, ash and birch.

Area 38: A few soft maples and hickories remaining after a cutting two years ago; reproduction composed of coppice growth of these same species; the area for the most part covered with rank grass and weeds.

Area 39: A stand of 11 to 20 year old maple, with a little ash and black birch.

Area 40: Clear cut two years ago. A scant hard maple coppice



and a rank growth of weeds and blackberry bushes occupy most of the site.

Area 41: Some fine 80 to 100 year old hemlock trees remain here. The stand can be called all-aged hemlock, beech and maple.

Area 42: A 21 to 30 year old stand of chestnut, oak, and a small amount of maple.

Area 43: The upper half of the slope here is covered with an all-aged growth of beech, maple and oak; the lower half (Area 44) has been lumbered and, though pastured, is classed as old field with much scrub hardwood and hemlock.

Area 45: Stand of the same age as the next following, but more varied in composition, consisting of hard maple, beech, large-toothed aspen, black birch and cherry.

Area 46: A 10 year old hard maple coppice, with a number of scattered maples and beeches remaining from the previous stand.

Area 47: A 21 to 30 year old stand of oak, soft maple and trembling aspen, of poor quality, being former old field growth.

Area 48: An almost fully stocked old field type.

Area 49: Same as 48 but density is only about 0.5.

Area 50: An 11 to 20 year old stand of chestnut, oak, and some beech and maple.

Area 51: All-aged maple and beech, with some oak and hemlock in which recent heavy selection cutting has made frequent openings. There is considerable maple and beech undergrowth.

Area 52: An 11 to 20 year hard maple coppice, but with much aspen, beech and cherry in places.

Area 53: A stand of all-aged maple, basswood, beech and hemlock.

Area 54: A stand of all-aged chestnut, red and white oaks, maple and cucumber trees. Salvage cuttings of chestnut have made frequent openings.

Area 55: Clear cut three years ago, and now occupied by a dense growth of chestnut, oak and beech coppice.

Area 56: A 0.6 stocked old field, carrying some chestnut, red oak and soft maple.

Area 57: A stand of 20 year old hard maple, ash and beech, with hemlock of all ages scattered through it.

Area 58: Cut over 5 years ago; reproduction is aspen, sumac and soft maple.

Area 59: A stand of 71 to 80 year old beech, hemlock, maple and ash. In the western half all hemlock had been cut by the time

this survey closed (September 15); the hardwood was to be removed later.

Area 60: A 0.6 stocked old field.

Area 61: Cut over 11 to 20 years ago, but many beeches and maples were left in places. Most of the area is now covered with hard maple, beech, ash, black birch and cherry, with an understory of hemlock in some parts.

Area 62: The west quarter of the area has 21 to 30 year old yellow birch, hard and soft maple and basswood, with a predominance of hemlock aged ten years older. This is replaced with pure trembling aspen and a small amount of hemlock in the understory—a transitory type.

Area 63: A stand of 21 to 30 year old hard maple, with a liberal amount of cherry and, at the eastern end, considerable beech and some cherry left from the previous stand.

Area 64: All-aged beech, hard maple, basswood and a little black birch.

Area 65: Formerly old pasture, but now carrying 20 year old pure hard maple, except for the central part, which is 0.7 stocked with black birch, hornbeam and apple.

Area 66: Clear cut 7 years ago, but now covered with hard and soft maples, red oak, black birch, beech and, on the lower half, with hemlock, which is older than the hardwoods.

Area 67: A 0.7 stocked old field, still used as pasture.

Area 68: Clear cut 5 years ago, and is now covered with maple, beech, chestnut and oak.

Area 69: A stand of 11 to 20 year old red and white oaks, soft maple, chestnut and cucumber tree.

Area 70: A stand of all-aged beech, red and white oaks, maple and, on the hill-top, chestnut.

Area 71: An old field of varying density. The more valuable trees are maple, ash, and scattered white pine.

Area 72: A 0.5 stocked old field.

Area 73: A stand of 41 to 50 year old soft maple, oak and chestnut; the chestnut has died and left many openings in the upper canopy, which has encouraged the development of the undergrowth.

Area 74: A forest of 41 to 50 year old oak, maple and birch. Underbrush is absent because of grazing.

Area 75: Old field, the lower part covered with open-grown oaks.

Area 76: A stand of 31 to 40 year old oak and chestnut, with a little maple.

Area 77: Almost completely stocked old field; the lower south part with an all-aged stand of oak, beech and maple, and designated as Area 78.

Area 79: Clear cut 10 years ago, and now covered with oak coppice and chestnut, the latter now largely dead.

Area 80: An all-aged stand up to 60 years of almost pure oak and chestnut except for the eastern half, which contains tulip, ash and maple in addition to oak and chestnut.

Area 81: A 0.4 stocked old field.

Area 82: A 61 to 70 year old stand of oak, maple and birch; but the lower slope was clear cut five years ago and is now covered chiefly with weeds.

Area 83: Old field, 0.4 stocked.

Area 84: A stand of 41 to 50 year old red and white oaks.

Area 85: A stand of 41 to 50 year old oak and chestnut.

Area 86: A stand of all-aged beech, oak, maple and hemlock, with considerable white pine present along the northern edge.

Area 87: Except for a hemlock understory, was clear cut 7 years ago. There is now a very dense growth of maple, basswood and beech coppice and seedling black birch and hemlock.

Area 88: A 51 to 60 year old stand composed, on the upper slope, of maple and beech, with some ash and white pine, and on the lower slope contains, in addition, considerable hemlock. Yellow birch is present along the Run (North Branch Sawmill).

Area 89: A 0.5 stocked old field containing soft maple and a little white pine, besides the inevitable thorn apple.

Area 90: The lower slope, for 500 feet north from the Sawmill Run road, except for the younger scattered hemlocks, was cut over about 5 years ago. The present hardwood coppice is mostly hard maple. To the north is a 50 year old stand of sugar maple, beech and a little hemlock. This growth is, however, younger on the eastern edge and is slowly spreading into the adjoining pasture.

Area 91: Here is a fine over-mature stand of beech, maple, hemlock and some oak, extending north up the hill from Sawmill Run for nearly a half mile to an area clear cut about 5 years ago but now composed of a dense coppice stand of the original species.

Area 92: A tract with a thick understory of mixed hardwoods which includes witch hazel, beech and ash. Scattered large trees stand above this, but on the western side of the area many have been removed, leaving openings where some blueberry bushes have taken root. An area of about 3 acres, toward the top of the ridge, bears a

very dense growth of cherry, maple, oak and sumac. West of this is an area (size not determined) cut over about 5 years previously.

Area 93: A 11 to 20 year old mixed hardwood stand of red and white oaks with a little maple.

Area 95: The upper story, because of recent salvage cuttings of chestnut, is now understocked. The trees, 61 to 70 years or more in age, include oak, poplar, hard maple and hickory. The understory is dense and composed of the same species.

Area 96: An understocked stand of white and red oaks and hard maple, reduced to the present density by a selection cutting 3 to 5 years ago; the understory composed of oak and maple coppice, with the inevitable witch hazel and other weed species.

Area 97: A former pasture, now forested with 11 to 20 year old hardwoods, principally red and white oaks.

*Subdivision 3. (Bone Run. Areas 98-130 inclusive).*—Area 98: A stand of beech, oak and maple in which small openings have been made in recent years by hardwood cuttings. These cut-over areas have considerable reproduction.

Area 99: Much like the preceding, on the upper slopes, but on the lower has considerable hemlock which is about 20 years older than the hardwoods.

Area 100: Consists of scattered hemlocks with an undergrowth of oak and maple coppice and a few valueless species. Openings have been made by small cuttings for firewood. The area is very swampy and covered with blue beech in the lower part.

Area 101: Old field type with a density of about 0.7. The valuable species are oak and maple, with some hemlock and beech.

Area 102: A stand of 41-50 year old hard maple, hickory and beech.

Area 103: Old field, with many sprout hardwoods from originally open-grown trees.

Area 104: Clear cut, except for scattered hemlocks, 5 to 10 years ago. Maple coppice is very dense in spots, but brush piles have choked it in others. Many large trees remain in the middle of the area where cutting was light, and the same is true of the western part where most of the trees left are beech, hemlock, basswood and hickories. The reproduction here is hard and soft maples, hickory, oak and basswood coppice.

Area 105: Old field, only partly stocked with hickory, butternut and maple, and much thorn apple.

Area 106: Old growth, mostly hemlock and maple.

Area 107: An area covered with a very dense sprout hardwood stand, chiefly of hard maple, mostly 20 years old. An occasional beech and maple remain from the previous stand.

Area 108: Clear cut about 5 years ago and now covered with a very dense coppice of hard and soft maple, black and yellow birch, oak and other hardwoods.

Area 109: Clear cut 3 to 4 years ago and now bearing a rather scanty coppice growth of maple and basswood.

Area 110: Except for the age-classes 1 to 20, the stand is all-aged beech, maple and a little basswood and ash.

Area 111: Clear cut 5 years ago; has grown up to hard maple, black birch, beech and a little hemlock.

Area 112: An all-aged stand of beech, maple and black birch.

Area 113: Clear cut at various periods, 5 to 20 years ago; the reproduction is hemlock, hard maple and black birch.

Area 114: Clear cut 7 or 8 years ago, and now stocked with hard and soft maples, red and chestnut oaks, and chestnut.

Area 115: A stand of 11 to 20 year old hard maple, red oak, black birch, beech, aspen, and, in the small valley shown on the contour map, yellow birch and hemlock.

Area 116: Clear cut at the same time as the preceding; has a dense growth of chestnut, black and chestnut oaks, and a small amount of cucumber trees and cherry.

Area 117: A stand of 21 to 30 year old red and chestnut oaks and chestnut, but patches of the previous stand, 51 to 60 years of age, remain in places.

Area 118: A stand 80 years of age and over, of oak, chestnut, beech, and maple.

Area 119: A 21 to 30 year old stand of red and chestnut oaks and chestnut.

Area 120: Burned over about 25 years ago; the ground litter so thoroughly destroyed that it is now nearly everywhere scanty and in places entirely wanting. The slope is under-stocked with a 25 year old stand of red and white oaks, though the younger growth of oak is fairly thick. In isolated spots there is considerable maple and beech.

Area 121: A two-aged stand of 41 to 50 year old red and white oaks and 81 year old or over hemlock. A recent selection cutting has removed much of the hemlock.

Area 122: A stand of 11 to 20 year old red and white oaks, with a considerable amount of large-toothed aspen, and hemlock in the eastern part.



Area 123: This and area 124 is old field, now completely stocked.

Area 125: A 11 to 20 year old stand of trembling aspen, maple, sumac and wild black and fire cherries.

Area 126: An old field type, with only the western part showing some promise of a fair stand from the forester's point of view. Aspen, oak, maple, white pine and hemlock are regaining possession.

Area 127: A rather open stand of 41 to 50 year old oak, maple and hickory.

Area 128: It was noted that the soil here was of poor quality. The upper cover of 41 to 50 year old (possibly older) black and white oaks, maple, chestnut and large-toothed aspen, is incomplete and is evidently being removed by selection. The only valuable reproduction is oak.

Areas 129 and 130: Much alike, but the older age class of area 129 has been completely removed, and the reproduction was not so good as in the following area. Scattered red and white oaks, 41 to 50 years of age, stand above a 10 year old coppice and seedling growth, chiefly of oak and hard maple.

*Subdivision 4. (North Branch Bone Run. Areas 131-182 inclusive).*—Area 131: A two-storied stand, the upper consisting of scattered maple and beech, mostly of large size but of poor form, and hollow; and the lower, aged 20 to 25 years, mostly of beech, though hard and soft maples, oak and hornbeam occur.

Area 132: A dense growth of hardwoods, mostly of poor form, with hemlock and scattered white pine.

Area 133: Former old field, in the upper part densely stocked with hard maple, blue beech, beech, ash and hemlock. The lower slopes are more open.

Area 134: Old field, now densely stocked, but with worthless species.

Area 135: Is also old field type of little value.

Area 136: Much like area 133, with the exception of hemlock.

Area 137: A stand 10 to 20 years old, much like that of area 132, with the addition of a few large scattered maples and a prominence of hemlock in the north part of the area.

Area 138: Blue beech occupies most of the ground, though there is a rather open upperstory of hemlock, hard and soft maples, ash, elm and white pine.

Area 139: Clear cut 10 years ago. Blue beech now is the principal species, but the more valuable kinds are red and white oaks and

hard maple coppice, with considerable trembling and large-toothed aspens, a little basswood, and some thickets of beech.

Area 140: A stand of 41-50 year old black birch, hard and soft maples, beech, black and red oaks, white ash and chestnut. Cutting, mostly group selection, is going on here on a small scale.

Area 141: A stand of 11 to 20 year old black birch, yellow birch and hard maple, with older growth in the small side-valley.

Area 142: The upper story consists of scattered oak, maple and beech which has been removed on the lower side for a depth of 100 feet. Most of the stand is 21 to 30 year old trees of the same species, with much undergrowth.

Area 143: Old field and, except for a few hemlocks, has but little commercial value.

Area 144: Bears a fine stand of 41 to 50 year old yellow birch (along a ravine not well shown on the map), beech, maple and some ash. Selection cuttings are being made. The trees have particularly fine form.

Area 145: An old stand of hard maple, beech, hemlock and tulip. A heavy selection cutting was made here during the winter of 1925-26, leaving many large openings.

Area 146: Here the forest is composed of hard maple, basswood and ash, 31 to 40 years of age, with a fair undergrowth of maple and ash. On the higher part of the area there is a patch of beech and maple, about 51 to 60 years of age.

Area 147: An all-aged stand of maple, beech, basswood, ash and black birch. The maximum age is 70 years. A cutting made 10 to 15 years ago left scattered patches of hard maple and black birch reproduction in the openings.

Area 148: Group selection cuttings and small clear cuttings have been made over this area during the past five years, leaving untouched fringes of beech, maple and ash of the same type as on the preceding area. The cut-over patches are now covered with hard maple and basswood coppice.

Area 149: A stand of 31 to 40 year old maple, beech and basswood, with scattered older trees, and much maple, ash and beech in the undergrowth.

Area 150: A stand of 10 to 20 year old hard and soft maples, oak, chestnut, black birch and aspen, with scattered oaks about 10 years older in the southern quarter of the area.

Area 151: About 0.5 stocked with 80 year (and over) maple, beech and hemlock. A maple understory 11 to 20 years of age, completes the stand.

Area 152: Clear cut 5 to 7 years ago, except for cull trees, which increase in number towards the southern end of the area. The dense reproduction consists of hard and soft maples, ash, oak, black birch and beech.

Area 153: A maple and beech forest 51 to 60 years of age.

Area 154: Chiefly aspen and maple. Most of the maple is on the upper slope, about 21 to 30 years of age.

Area 155: Clear cut all at one time (except for scattered hemlock); has a growth of maple, beech, black birch and aspen.

Area 156: A stand of 61 to 70 year old maple, beech and hemlock.

Area 157: Occupies the valley bottom of the main stream and of the north fork of the brook flowing east from the vicinity of the county line into the North Fork of Bone Run; has no real forest growth, but contains an aggregation of many stands, with a dense growth of swale grass, alders and weeds occupying much of the ground.

Area 158: Consists of 11 to 20 year old maple and beech, the beech predominating on top of the ridge.

Area 159: The stand is 41 to 50 year old maple, ash and beech, with occasional hemlocks in the southern half of the area.

Area 160: Most of the stand is coppice of mixed hardwoods, the principal species being hard and soft maples, oak, black birch, chestnut and poplar.

Area 161: Cut over 5 years ago, but many maple, chestnut and oak saplings were left standing. The reproduction comprised coppice growth of the above species and seedling black birch.

Area 162: The main stand of 51 to 60 year old maples, oak, ash, chestnut (in poor condition, due to blight) and occasional cucumber trees, is open, due to a selection cutting 10 to 15 years ago. The understory of maple, oak and black birch is dense.

Area 163: 41 to 50 year old maple, oak, beech and chestnut.

Area 164: Clear cut, except for old, poorly formed maples and beeches, 5 years ago. Reproduction is dense and consists of hard and soft maples, chestnut, ash and some poplar and cucumber trees.

Area 165: An old field of greatly varying density.

Area 166: Clear cut 6 to 8 years ago. Abundant reproduction of black birch, oak, maple, beech, cherry and a little hemlock.

Area 167: Consists of 21 to 30 year old oak and chestnut, the latter in very poor condition.

Area 168: A stand of red and white oaks 21 to 30 years of age.

Chestnut forms a considerable but diminishing part of the stand in the northern section.

Area 169: A dense stand of hard and soft maples and oak, 5 to 10 year of age. Though open to grazing, little effect is as yet evident.

Area 170: With the exception of older individual trees, the stand is 61 to 70 years of age and composed of maple, beech, cucumber tree and oak, with an understory of soft maple.

Area 171: An old (80 years or over) stand of beech, maple and chestnut. Some selection cutting has been done and the openings are now filled in with slash and weeds. The more open parts of the stand, where the weeds were not encouraged by the sudden opening up, have an understory of beech, maple, cucumber and oak.

Area 172: A stand consisting of beech, maple, and hemlock at least 80 years of age, with an understory of beech. A lumbering operation removed principally maple from this area in 1923.

Area 173: Much like area 172, but not recently lumbered.

Area 174: A very heavy selection cutting occurred three years ago. Many maples, beeches, and cucumber trees of large size but poor quality remain as well, as trees below merchantable size. There is a considerable amount of coppice, chiefly maple.

Area 175: Composed of 71 to 80 year old beech, maple and basswood, with occasional much older individuals.

Area 176: Clear cut 5 years ago. The hard maple, black birch and black cherry growth is very dense.

Area 177: An all-aged stand of hard maple, oak, ash, beech and tulip, with abundant reproduction.

Area 178: An all-aged stand composed of hemlock, yellow birch and maple.

Area 179: An all-aged stand of hard maple and beech, with abundant reproduction.

Area 180: A 20 year old dense growth of hard maple, with a little basswood and black cherry.

Area 181: Clear cut 3 years ago, except for isolated trees. The reproduction is maple, elm and ash.

Area 182: Completely stocked old field.

*Subdivision 5 (Phillips Brook. Areas 183-192 inclusive).* Area 183: Clear cut 5 years ago and now covered with a very dense coppice growth of tulip, hard and soft maples and white ash.

Area 184: The stand here is dense, with scanty undergrowth. The majority of the trees, except for scattered older ones, are 21 to 30 year old ash and hard maple.

Area 185: A stand of 20 year old maples and beech, with scanty undergrowth. The chestnut was removed about 10 years ago, and the subsequent sprout growth has been killed by blight.

Area 186: Mostly old field type, about 0.7 stocked with black birch, maple and poplar. The higher elevations are, however, fully stocked with 21 to 30 year old hardwoods, but the undergrowth is rather scant.

Area 187: Principally 31 to 40 year old hard maple, with a mixture of beech, chestnut and ash.

Area 188: A stand of 1 to 10 year old hard maple, with occasional larger tulips, maples, oak and hemlock.

Area 189: The stand is all-aged beech, hemlock, maple and some ash.

Area 190: A 0.7 stocked old field. None of the species are commercially valuable, but offer good cover and protection for game.

Area 191: A 5 year old reproduction of coppice maple and seedlings of birch and bird cherry. There is much large but scattered hemlock in the southern half of this area.

Area 192: This area is occupied by an inferior stand of willow, blue beech, yellow birch, and, in the lower part, trembling aspen—characteristic of the cut over areas along the valley bottoms.

*Subdivision 6 (Pierce Run. Areas 193–210, 212–220, inclusive).*

Area 193: Except for a few scattered hemlocks, this area was clear cut 8 years ago. The reproduction consists of hard and soft maples, black birch, basswood and cherries.

Area 194: Pasture, but mostly grown up to birch, blue beech, and some hemlock and elm.

Area 196: A very heavy selection, or a group selection, cutting was made here 15 years ago. About one-half of the area is covered with large beech, maple, etc. The reproduction consists of the same species.

Area 197: This area is similar to the preceding except that no cutting has been done.

Area 198: Cut over about 8 years ago, but scattered hemlocks, birch and beech were left. The present stand is principally hard maple, cherries, basswood, blue beech and black and yellow birches.

Area 199: In poor condition from the forestry viewpoint. The soil is too wet to permit classification in Quality I, and the stand of basswood, black and yellow birches, willow, elm and considerable hemlock, is irregular and contains frequent open spaces overgrown with rank grass and weeds.



Area 200: A thick 20 year old stand of hard maple, with scattered large maples and beeches.

Area 201: Much like the preceding, but with a lesser variety of species such as fire cherry and birch.

Area 203: Hard maple of 11 to 20 years, with no underbrush. The section of this area west of the open field which limits it on the south, is old field type, consisting mostly of hard maple, with some bird cherry.

Area 204: Retains beech and maple remnants (mostly hollow) of the previous stand which was removed about 5 years ago, but which has been replaced by maple, with some beech and oak.

Area 205: Maple, beech, ash and hemlock somewhat younger than the growth of the preceding area.

Area 206: A stand of 41 to 50 year old hard maple, with some beech.

Area 207: Old field, almost fully stocked. The valuable species are maples, black birch and beech.

Area 208: A stand of oak, maple and white pine, 80 years of age and older, with relatively heavy reproduction.

Area 209: A stand of 15 year old hardwoods; red oak predominating.

Area 210: A stand of 71 to 80 year old oak, maple, and a little pine and hemlock.

Area 212: A promising stand of 15 year old white and red oaks, with some aspen and maple.

Area 213: Old field in the northeast corner 0.7 stocked with hickory, maple, and cherry.

Area 214: Clear cut about 20 years ago. The reproduction is oak, maple and chestnut.

Area 215: Chiefly old field, a portion of which is completely forested.

Area 216: Large scattered hemlocks tower over a 5 year old stand of maple coppice and seedling black birch.

Area 217: Similar to the preceding area, but older and with a greater variety of species.

Area 218: Clear cut about 10 years ago. A considerable portion has the appearance of old field, 0.8 stocked. The principal species are black and yellow birches, basswood, hard and soft maples, cherries and some oak. Beech forms dense thickets in places.

Area 219: Old field type consisting largely of scattered blue beech and some thorn apple. The upper slope, however, bears an

understocked stand of maple, beech and oak, with considerable chestnut, although most of the chestnut has not survived.

Area 220: An all-aged stand of yellow birch, maple and beech.

*Subdivision 7 (Hotchkiss Hollow and North to Boundary of Tract and Division II. Areas 211, 221-266).* Area 211: Old field, 0.4 stocked.

Area 221: Clear cut 5 years ago. The reproduction, with the single exception of poplar coppice, is maple and hickory.

Area 222: Cuttings, resembling group selection, were made here during 1925-26. The stand is 31 to 40 year old oak, ash, maple and beech, with abundant hard maple reproduction in the openings.

Area 223: An all-aged stand of maple, beech and a little magnolia.

Area 224: A very dense 11 to 20 year old stand of hard maple, with a slight mixture of cherry.

Area 225: All-aged beech, maple, ash, hemlock and cherry. Cuttings have been made in small patches and the resulting dense reproduction is chiefly hard maple.

Area 226: A stand composed of maple, beech, and some hemlock. The eastern half is 51 to 60 years old, but the western only about half as old.

Area 227: Old field type, almost completely stocked with maple, hickory, cherry, etc., with some old hemlock occurring near the corner of the Hotchkiss Hollow road (northeast section of the area).

Area 228: A stand about 30 years old, with promise of becoming especially valuable. The trees, which due to early over-stocking are of very good form, are yellow birch, hard maple, beech, hemlock and cherry.

Area 229: Most of the area is forested with a 21 to 30 year old stand, but has a few scattered trees 80 years of age or older. The species are red and white oaks and chestnut, with some cucumber trees, tulip, white pine and maple.

Area 230: A 21 to 30 year old growth of maple, birch and beech, with blue beech a predominant weed species.

Area 231: The stand is all-aged but the larger trees are very old—well over a hundred years—and many, if not all, are hollow. The species are red and white oaks, maple, hemlock, birch, beech, and a small amount of white pine and cucumber trees. Selection cuttings were being made here at the time this survey was made.

Area 232: Practically the same in composition as the preceding, with the older trees removed, but the main stand is 11 to 20

years of age. There is some pine reproduction in openings caused by selection cuttings of seven years ago.

Area 233: Partly cut over 5 years ago, leaving scattered patches of 41 to 50 year old maple, oak and hemlock. The majority of the reproduction consists of hard maple and black birch.

Area 234: Old growth (over 100 years) oak, maple, hornbeam and magnolia. Reproduction is fairly abundant. This stand is undoubtedly over-mature, and will yield an excellent grade of lumber.

Area 235: More or less completely cut over about 5 years ago, most heavily on the northern side, near the road and grading into a selection cutting farther up the slope, where 80 year old beech and maple form over one-half of the present cover. The reproduction consists of hard and soft (red) maples, black and white oaks, and other hardwoods, on the lower slopes, in mixture with considerable hemlock which was left uncut.

Area 236: Old field type about 0.7 stocked. The only valuable species are hickory and maple, which are much out-numbered by the weed species.

Area 237: A 61 to 70 year old stand of oak and chestnut, open and of only third quality.

Area 238: Chiefly abandoned pasture (old field type), 0.8 stocked with hickory, maple, beech, oak and chestnut. This grades on the east into a 41 to 50 year old oak, maple and chestnut stand.

Area 239: The precipitous hillside supports a middle-aged stand of maple, ash, hickory, oak and scattered hemlocks.

Area 240: Practically clear cut about 7 years ago, except for occasional worthless trees. The reproduction consists of oak, maple and magnolia, with a predominance of beech.

Area 241: A fine stand of ash, maple, oak and magnolia 100 years of age and older. This stand will undoubtedly produce some of the best hardwood timber of the entire tract.

Area 242: Clear cut 5 years ago, but now reforested with a dense growth of hard maple, black birch and beech.

Area 243: Previous to a wind storm three years ago, there was here a fine stand of old timber consisting of maple, beech and hemlock. Many trees were then blown down and the openings are now thickets of reproduction, mostly of maple.

Area 244: A 31 to 40 year old stand of maple, basswood, beech, black birch and scattered hemlock.

Area 245: Consists of 31 to 40 year old maple, chestnut, hickory and black oak. It is very open (due to a dry site) and much of the ground is occupied by grass and ferns.

Area 246: Old field type, 0.4 stocked. The better species, maple, hickory and ash occupy most of the ground which is stocked.

Area 247: A very dense stand of 11 to 20 year old hard maple and beech.

Area 248: Consists of hard and soft maples, black and white oaks, chestnut, magnolia, cherry, and ash about 21 to 30 years of age. This area was clear cut 5 years ago. There is some dead chestnut, including large trees as well as the coppice reproduction.

Area 249: Consists of a 51 to 60 year old pure stand of hard maple.

Area 250: Clear cut 5 years ago. Most of the chestnut coppice, which was an important part of the reproduction, is dead and the remaining species are oak and maple, although some chestnut still survives.

Area 251: A 20 year old hard maple stand, free from undergrowth because of grazing.

Area 252: Practically the same as area 250 on the east, but here an even greater percentage of the stand was chestnut, the death of which has left the area much under-stocked and covered with weeds and briars. Scattered white and red oaks, maple and hickory, about 21 to 30 years of age, remain from the previous stand.

Area 253: This area was clear cut 10 years ago with the exception of an occasional large, defective tree and small patches of 31 to 40 year old red and white oaks and maple. The growth is very dense and is composed of hard and soft maples and chestnut coppice.

Area 254: Old field type, still pastured although about 0.8 stocked. The more worthy species are hickory and chestnut.

Area 255: The growth here has not been affected by overgrazing in the past. Most of the trees were removed three or four years ago but there is now a very dense hard maple reproduction.

Area 256: Another section difficult to describe without considerable subdivision. The lower part is chiefly pasture, containing a block of red maple, aged 31 to 40 years. The soil here has an excessive amount of moisture. The higher ground was formerly old field type, but is now forested with red maple, and toward the hill top, a very dense growth of 11 to 20 year old hard maple.

Area 257: Dense hard maple, with a little cherry and hemlock.

Area 258: An excellent stand, 80 years of age and older, of maple and beech, with some ash, chestnut and hemlock. The timber is mature and of high quality. The seedling reproduction is hard maple.





Fig. 5. A wooded pasture in Division II. Neither grazing nor forests are used to advantage; this is also poor habitat for most game except gray squirrels, although grouse may find cover in the denser brush.



Fig. 6. Former agricultural land. This photograph, taken near Vollentine, shows the first stage in reversion to forest.





Fig. 7. Thorn Apple (*Crataegus* sp.).



Fig. 8. Bird or Pin Cherry (*Prunus pennsylvanica*).

Area 259: Former old field type, but now completely stocked with hard and soft maples, witch hazel and hickory.

Area 260a: Clear cut 5 to 7 years ago. The reproduction of oak, chestnut, hemlock and maple is of satisfactory density.

Area 260b: Open, due to the dryness of the site, but composed of 11 to 20 year old soft maple and chestnut.

Area 261: A fine stand of maple, beech, oak, hemlock and ash over 80 years old.

Area 262: Clear cut 5 years ago; the reproduction of maple, chestnut and oak, is mostly coppice.

Area 263: An 0.8 stocked old field type, still used as pasture. The species are hard and soft maples and some chestnut.

Area 264: Pastured, and about half covered with a stand of varying density of hard maple and ash.

Area 265: A stand of 11 to 20 year old beech, maple, black birch and large-toothed aspen.

Area 266: This area was cut over 2 years ago, when about 75 per cent of the merchantable trees were taken. Those left are maple and beech, and there is but little reproduction.

**Division II: Areas Principally Unforested.** Area 267: A stand 41 to 50 years of age and composed of chestnut, oak, maple and ash. The central half of the area, in a strip running from the higher to the lower side, was clear cut 3 to 4 years ago, and here is a thick coppice growth of chestnut, maple and oak.

Area 268: Contains 21 to 30 year old maple, beech and a little hemlock, and is open as a result of grazing by cattle.

Area 269: An 0.8 stocked old field type; chiefly soft maple and beech.

Area 270: Cut over 3 to 4 years ago, but scattered trees were left. These are in poor condition due to removal of their neighbors and are either broken or sun-scalded. The land is now used as pasture and as a result the chestnut and maple coppice is damaged.

Area 271: A stand of very limby 21 to 30 year old soft maple, the result of a poorly stocked old field.

Area 272: A stand 8 to 10 years of age, consisting of hard and soft maples, chestnut and beech coppice, black and yellow birches and aspen seedlings.

Area 273: An abandoned pasture, now forested with an all-aged stand of maple, beech, blue beech and some oak.

Area 274: This area is now devoted to sheep pasturing, the harmful effects of which can be seen in figure 35. The results of

such grazing on the undergrowth is here clearly illustrated. The area is about one-third stocked with dense stands of hard maple and hickory and some sumac. There is, of course, no underbrush, as the sheep browse everything succulent as high as they are able to reach.

Area 275: Forested with a 21 to 30 year old stand of maple, chestnut and trembling aspen in mixture with a considerable number of fire cherry and sumac.

Area 276: An area of very irregular types. About three-quarters of the area is really agricultural and is utilized either for hay crops or for pasture. As pasture, however, it produces very little forage because where it is not wooded it is covered with a dense growth of ferns, which are not touched by cattle. The north end of the wooded part of this area contains a fine sugar orchard.

Area 277: A stand much varied both in age and composition. Along the brook is all-aged beech, hemlock and maple. The younger sections of the area have more yellow birch, with a little black birch. The pastures, especially on the eastern side of this area, are seeding in to hemlock. A white pine plantation has been made on the western side of the brook, by the Water Company or Commission of Randolph. This area is the only one in the tract with a forest used solely for watershed protection, the brook flowing through it being the main source of supply for the Randolph village reservoir.

Area 278: A fine "sugar bush," aged about 41 to 50 years.

Area 279: This is in very poor condition either from the forestry or the agricultural viewpoint. It is mostly grazed and is especially open in the southern half. The forested areas are patchy and the openings are grassy. The trees are from 30 to 80 years of age, depending on the locality, and are maple, beech, yellow birch and hemlock.

Area 280: A small section of the preceding, which was cut over under the selection system some years ago. There are many large and small openings filled with maple and birch reproduction.

Area 281: Forested with 40 year old beech, maple and a little yellow birch.

Area 282: Old field type, about 0.5 stocked with large, limby hemlock, maple, beech, yellow birch and a little white pine. A small cutting was made during the winter of 1925-26, on the eastern side of the bottle-shaped opening near the crest of the hill.

Area 283: A stand of 51 to 60 year old hard and soft maples.



wild black cherry and a little ash, with an understory of hemlock on the east side of the tract.

Area 284: Divided into two parts by the westward extension of the pasture occupying the more level land northwest of the Sample Hill School. The stand is composed of maple, beech, pig-nut hickory and ash 80 years of age or older.

Area 285: At present used as a pasture. The original hardwood stand was removed several years ago, with the exception of a number of scattered elms and a few maples. No sprouts have resulted from the stumps because of browsing by cattle. About 60 per cent of the area is now occupied by the original understory of 31 to 40 year old hemlock.

Area 287: Contains a good stand of maple, beech and ash, aged over 80 years.

Area 288: A 0.4 stocked old field type. The principal species is thorn apple.

## AREAL CLASSIFICATION AND DESCRIPTION OF THE WILD LIFE HABITATS

The forest description thus far has been limited to a résumé of the wooded areas of the tract from the point of view of forestry alone, namely, the growing of forest trees. From the viewpoint of wild life requirements, however, this tract may be treated in an entirely different manner. In this connection one is concerned particularly with its suitability for various game and other animals, the character and quantity of their respective foods, the cover (including hollow trees for denning places for certain species), ranging space and any other requirements which might have a bearing on the capacity of the whole or of any particular section of the tract to support game or other species of animals.

In defining the animal habitats, the same divisions of the tract which answered the purpose of bounding the forest types will be used. In many ways this is unsatisfactory, for several adjoining areas, unlike from the forestry viewpoint, may have ground cover and food plants so similar as to be equally acceptable to certain species of birds or mammals. In many other cases, however, this is not true, and the boundary which limits a forest type may also limit the habitat of a certain form of wild life. This can be readily illustrated in an area which has been treated silviculturally in two ways. One section of it has been clear cut, five to ten years ago, and now supports a dense growth of hardwood coppice and seed-

lings, berry bushes, etc., and is inhabited by grouse and snowshoe rabbits. The other section adjoining was also cut at the same time, but instead of being clear cut, many scattered seed-trees (or culls, perhaps) of undesirable form and quality, but of large size, were left standing. By the present time this section will have coppice and seedling growth and food plants, much like that of the first section, where grouse and rabbits will also be abundant, moving back and forth across the lumberman's boundary, which for them, because it does not greatly affect their individual necessities of life, hardly exists at all. But the raccoon, whose den is in one of the isolated, large, hollow trees of the second area, has very little interest in the "brush" aside from the cover it may afford him on his way to the nearest stream, or for the berries found in it during the season. Therefore the clear-cut area supplies to the 'coon at best only a part of his food supply, while to the grouse and the rabbits it furnishes all, or practically all, the necessities of life. With such limitations in mind, therefore, the following descriptions of the wooded areas of the tract will perhaps give some idea of the capacity of the tract to sustain wild life.

For the description of the habitats, use will be made of the same map (Map 2) which was used for location of the different areas in the forest description, the numbering of the habitat areas corresponding, therefore, to that of the type areas on the map.

It will perhaps be noted that in the following descriptions the term "ground cover" is often used. It may be well to explain that the phrase is here meant to describe, not the litter, mosses, etc., of the forest floor, but shrubs and tree reproduction which would serve to hide the movements of such animals as rabbits and grouse. Thus, if it is stated that ground cover for the grouse is lacking, it should be understood that, although the canopy of the upper story may be complete, and the ground itself covered with trailing and other low plants, there are no foliage or branches within a few feet of the ground, which might screen the movements of such game or form an obstacle to their enemies in case of attack.

**Division I: Habitats Principally Forested.** *Subdivision 1 (South Boundary of Tract North to Browns Run. Arcs 1-24 inclusive).* Area 1: A fine grouse habitat. The cover is excellent, including a thick stand of hemlock, a rank growth of grass, and a large amount of débris (either brought down by the Run and piled in loose heaps or in the tops of fallen trees). This is also a good habitat for rabbits, and several cottontails were seen along the boundary road on the north known as State Line Run road.



Area 2: A very dense old field type with a predominance of trembling aspen. There is much *Viburnum*, and beech is prominent on the lower slopes. Hemlock is lacking, but the cover is of sufficient density for good protection of grouse and cottontail rabbits against hawks and owls, and for rabbits especially against the fox.

Area 3: Characteristic grouse habitat; a mixed stand with a good representation of beech and considerable undergrowth, and with a good number of logging roads and desirable openings. *Viburnum* is common, and raspberry bushes are plentiful in the openings. Ferns are thick on the forest floor, and there is much bird or fire cherry. It is likewise a good habitat for snowshoe rabbits.

Area 4: Covered with a dense growth of young hardwoods including oak and black birch; but there are also aspen, witch hazel and sumac. Some hemlock provides winter cover. There is much *Viburnum* and some wintergreen. The area is excellent for grouse and snowshoe rabbits.

Area 5: A small abandoned orchard beginning to revert to white pine and hardwoods. Such a condition is usually excellent for grouse and cottontail rabbits. Similar abandoned fields, but more completely stocked, found above all the open pastures on the south slope of lower Browns Run, are also likely places for these species of game. There is plenty of thorn apple, fire cherry, raspberry, blackberry, and similar forms of vegetation.

Area 6: A small abandoned pasture which has grown up to white pine, apple, wild black cherry and other characteristic species of this type. This is a good grouse habitat, and several dusting places (see Fig. 14) were seen.

Area 7: Holds promise only for raccoon, the stand being without ground cover but with scattered old trees.

Area 8: The all-aged red oak and maple forest, with hemlock understory, has plenty of partridge berry, *Viburnum* and some wintergreen, especially along the northern edge bordering the openings, the easternmost of which is 0.5 stocked old field. These furnish a habitat for cottontails while the wooded upper slope provides conditions for snowshoe rabbits, grouse and gray squirrels.

Area 9: This is old field type, almost wholly stocked with sumac, chestnut, oak, aspen, witch hazel, sweet cherry, a little thorn apple, beech and white pine, giving excellent cover for rabbits and grouse. Of grouse food there is much wintergreen, *Viburnum* and some partridge berry.

Area 10: The cover here is more complete than in area 9, the stand consisting of 11 to 20 year old hardwoods. Sumac has been

crowded out and oak is more prominent. This is also good grouse and rabbit habitat.

Area 11: A good grouse and cottontail rabbit habitat; it is old field of 11 to 20 year old deciduous trees, chiefly aspen, with some blue beech.

Area 12: The 41 to 50 year old chestnut oak and chestnut stand is attractive to gray squirrels, but except along the road, the cover is hardly thick enough for rabbits and grouse. There is, however, considerable grouse food such as wintergreen, blueberry and *Viburnum*.

Area 13: Burned over 3 years ago, it is now a tangle of maple and black birch reproduction with much golden-rod and blackberry, making a fine habitat for grouse and snowshoe rabbits. Gray squirrels find suitable conditions in the 31 to 40 year old beech.

Area 14: Includes in the upperstory, black birch, oak, chestnut and wild black cherry. There is much underbrush, ferns, partridge berry and some *Viburnum*, making the area suitable for grouse and snowshoe rabbits.

Area 15: A 0.4 stocked old field, containing witch hazel, wintergreen, *Viburnum*, blackberry, sumac and pin cherry—a fine feeding area for grouse.

Area 16: Raccoon and gray squirrel habitat is provided by large beech. A light surface fire two years ago destroyed the undergrowth, which, however, is now coming back.

Area 17: Wintergreen, *Viburnum*, black birch and black cherry provide plenty of food for grouse, but good winter cover is somewhat lacking.

Area 18: Also good grouse area, with cover, and with some black birch and wild black cherry.

Area 19: Although the cover is insufficient on part of this area, the remainder has a dense beech coppice reproduction with much *Viburnum* and wintergreen, thus making good snowshoe rabbit and grouse habitat. Some old beech and maple provide denning places for raccoons as well as for squirrels.

Area 20: A 0.1 stocked old field, which will be excellent for grouse when better cover shall have developed, for much wintergreen, thorn apple, blueberry and blackberry is found here.

Area 21: Has a dense growth of 11 to 20 year old hardwoods, with some *Viburnum* and wintergreen, making good conditions for grouse and snowshoe rabbits.

Area 22: As a game habitat this area is much the same as the preceding.

Area 23: A good grouse and snowshoe rabbit cover. Occasional

scattered hemlocks stand over a coppice growth of 4-5 year old hardwoods and very numerous black birch seedlings, with some witch-hazel. Blackberry and raspberry bushes are numerous and increase in quantity toward the lower side of the tract.

Area 24: The upper part of this area has considerable hemlock which offers shelter to grouse; otherwise the tract is poor for game purposes, being covered with a thick stand of hard maple coppice.

*Subdivision 2 (Sawmill Run and North and South Branches. Areas 25-97 inclusive).* Area 25: Former old field, now entirely closed, chiefly with a very dense stand of trembling aspen about 6 to 10 feet high. The openings are grass-covered. This combination makes excellent habitat for grouse and cottontail rabbit.

Area 26: Suitable for raccoon and gray squirrel. Hemlock in the northern part will provide good cover for grouse.

Area 27: Has a very dense growth of 11 to 20 year old maple, but has no ground cover and hence is not suitable for game in its present condition.

Area 28: Former old field type, fully stocked and excellent grouse habitat. The upper cover includes aspen, witch hazel and hornbeam; the ground is covered with grass and weeds.

Area 29: Isolated beech, left from the cutting 10 years ago, may provide for a few raccoons and gray squirrels. There is ground cover but probably not sufficient food for any considerable number of grouse.

Area 30: A very good locality for raccoon, with most of the stand attaining a desirable size, and a small part near the center being 80 to 100 years of age.

Area 31: A fairly good habitat for grouse, being a 0.3 stocked old field.

Area 32: May be included with area 33 (cut over, except for culls, during 1926) since the cutting of merchantable timber on this area was proceeding at the time of the survey, probably to be finished by the end of the winter of 1926-27. Many beech are being left standing, and thereby a suitable habitat for gray squirrels will still remain.

Area 34: Good grouse and snowshoe rabbit habitat, having cover, and some *Viburnum* among food species. Numerous scattered beeches and maples remaining from the previous stand provide for a certain population of raccoon and gray squirrel.

Area 35: Clear cut 5 years ago, and now has a very dense reproduction, including black birch. Blackberry was once abundant but is

now almost choked out; nevertheless the cover remains excellent for grouse and rabbits.

Area 36: An abundance of undergrowth and fallen débris, makes good cover for grouse and snowshoe rabbits.

Area 37: Good grouse and gray squirrel territory. The all-aged stand of beech is especially favorable for the gray squirrel.

Area 38: The 2 year old coppice is still scant and the ground is covered mostly with a rank growth of grass, weeds and blackberry bushes, making chiefly summer habitat for grouse and cottontail rabbits.

Area 39: A fair grouse habitat with cover of 11 to 20 year old maple, ash and black birch. Some partridge berry was found here.

Area 40: Clear cut two years ago and now has good cover with some blackberry bushes making a suitable habitat for grouse and rabbits.

Area 41: A fair amount of ground cover, and some partridge berry occurs under the old stand. The area now supports gray squirrels and raccoons.

Area 42: Considerable wintergreen and *Viburnum* together with some partridge berry furnish plenty of food for grouse.

Area 43: The upper slope which bears an all-aged beech, maple and oak forest, provides good habitat for gray squirrel and raccoon; the lower slope is represented by the next number.

Area 44: This is now pastured, but a great amount of scrub hardwoods, hemlock, ferns, and blackberry and raspberry bushes encourage the presence of grouse and rabbits, especially in summer.

Area 45: A very dense 10 year old maple coppice stand with such grouse food plants as black birch, wild black cherry, much *Viburnum* and some partridge berry.

Area 46: The 10 year old maple coppice is very dense and provides small game cover but no food. Scattered large trees were left from the previous stand as culls and these are attractive denning trees for raccoons.

Area 47: Occupied by former old field hardwoods and sumac, providing good cover and food for grouse and cottontail rabbits.

Area 48: Old field, almost fully stocked with hardwoods and sumac, with small quantities of blackberry bushes, making good habitats for grouse and cottontail rabbits.

Area 49: Similar to area 48, but is only half stocked.

Area 50: Suitable for grouse and snowshoe rabbits. The stand is 11 to 20 year old mixed hardwoods, and there is much *Viburnum*

and wintergreen, especially above the opening on the South Branch road, which is nearly closed old field.

Area 51: An all-aged hardwood stand, the larger trees of which are attractive to the raccoon. Frequent openings with considerable reproduction offer favorable locations for grouse and snowshoe rabbits.

Area 52: The coppice provides only fair cover, but there are in addition considerable patches of wild black cherry which offer fair snowshoe rabbit and grouse habitat.

Area 53: This all-aged stand of hardwoods, with a little hemlock, is good raccoon habitat, and offers good cover for grouse, especially in winter.

Area 54: Also good grouse and snowshoe rabbit habitat. Underbrush and other cover is adequate, and openings are frequent. Witch hazel and partridge berry are plentiful.

Area 55: Clear cut 3 years ago, and is now a dense tangle of hardwood coppice and witch hazel. There is some blackberry and wintergreen and the area should be attractive to snowshoe rabbits and to grouse.

Area 56: Old field type containing much food for grouse, in the form of thorn apples, witch hazel and wintergreen.

Area 57: Grouse and snowshoe rabbit habitat. The cover is good and among food plants there is some shad bush and much partridge berry and *Viburnum*.

Area 58: Clear cut 5 years ago and now offers good cover for grouse and rabbits. Much sumac and blackberry are to be found.

Area 59: This will be destroyed as a habitat for animals of the tree tops, but partridge berry is now very abundant, and coppice and other reproduction which will replace the stand now being cut should make this a fine grouse area.

Area 60: A 0.6 stocked old field type. Apple, blue beech, witch hazel, thorn apple, sumac and some blackberry make this an excellent habitat for grouse.

Area 61: The grouse in area 60 are here afforded much protection by a hemlock understory, and some food in shad bush, blue beech, black birch, mature beech, black cherry and thorn apple, while raccoons and gray squirrels will find in the older beeches and maples attractive denning places.

Area 62: One of the few areas favorable for woodcock. Cover is excellent and the ground is very moist but without standing water. Grouse also find cover here, but little food except yellow birch.

Area 63: Ground cover is here practically absent and it is im-



probable that this area can, in the near future, be classified as suitable for wild life purposes.

Area 64: An all-aged stand, with beech as the principal species, it is a habitat only for gray squirrels and raccoons, though the presence of the latter is somewhat doubtful since the largest trees are probably less than 80 years of age.

Area 65: Formerly old field; has little ground cover except in the central part where there is also black birch, hornbeam and apple, offering thus fair grouse habitat.

Area 66: Excellent habitat for grouse and snowshoe rabbits, being covered with 7 year old coppice, birch seedlings, much blackberry, and considerable *Viburnum* and partridge berry.

Area 67: A 0.7 stocked old field type, suitable for rabbits and grouse.

Area 68: Clear cut 5 years back; has a dense growth of coppice and a considerable amount of witch hazel and blackberry. Should support grouse and rabbits.

Area 69: Has a fair amount of undergrowth and partridge berry and should be suitable for grouse and snowshoe rabbits.

Area 70: The all-aged beech, black and white oaks, maple and chestnut provide good conditions for gray squirrel and raccoon. The cover is good also for snowshoe rabbit and grouse; among food species for grouse there is much *Viburnum* and some partridge berry.

Area 71: Reverting to hardwoods, which are very unevenly distributed, being lacking in some places but dense in others. This will be excellent habitat for grouse and cottontail rabbits in perhaps 5 to 10 years, if the area continues to lie idle.

Area 72: Old field type 0.5 stocked with maple, thorn apple and witch hazel; has much wintergreen and blueberry. Suitable for grouse and cottontail rabbits.

Area 73: Has much underbrush and is fair habitat for grouse and cottontail rabbits.

Area 74: Has very little underbrush, due to grazing. The edges of the surrounding openings are reverting to old field type.

Area 75: Old field, containing much sumac, blueberry, huckleberry and sweet fern, with open-grown oaks in the lower part. The area is suitable for grouse and cottontail rabbits.

Area 76: Formerly old field, but now almost covered with oak and chestnut of varying ages, with much wintergreen, blueberry, *Viburnum*, and some partridge berry. Grouse, gray squirrels and rabbits find good habitat conditions here.

Area 77: Old field, nearly forested with sumac, chestnut, oak



Fig. 9. Sumac (*Rhus typhina*).

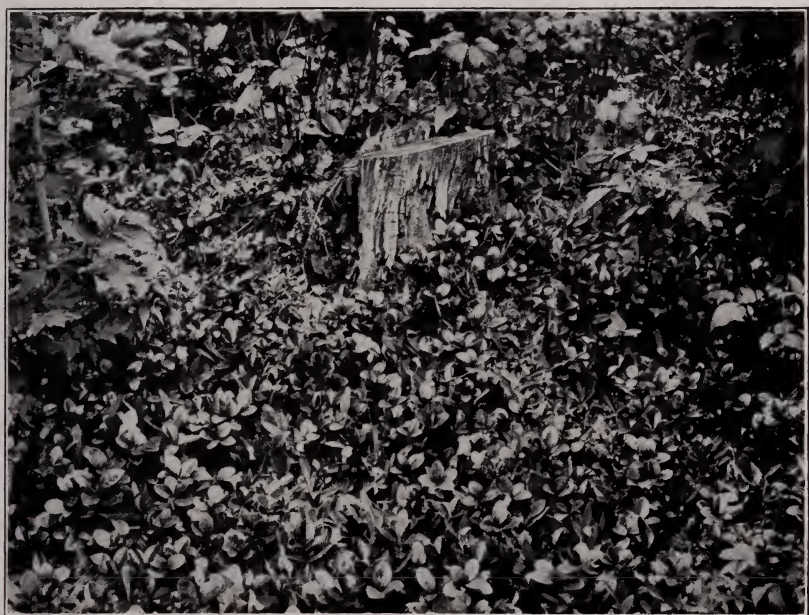


Fig. 10. Wintergreen (*Gaultheria procumbens*).





Fig. 11. High Bush Blueberry (*Vaccinium corymbosum*).



Fig. 12. Partridge Berry (*Mitchella repens*).

and thorn apple. There is much wintergreen in places and the area is excellent for grouse and rabbits.

Area 78: Carries all-aged hardwoods, including oak and beech, which provide good conditions for gray squirrels. Much wintergreen and *Viburnum* and some partridge berry occur. Snowshoe rabbits would also find suitable habitat here.

Area 79: Due to the chestnut blight, this area now has a practically pure stand of oak, 10 years old. The density, however, is good, and there is much wintergreen and *Viburnum*, making good habitat for our principal woodland small game species.

Area 80: Has promise for gray squirrels in the oak and chestnut. Much wintergreen and *Viburnum*, with some blueberry, provide much food for grouse.

Area 81: Old field type 0.4 stocked with thorn apple, and in places overgrown with ferns. It would in time make an excellent area for rabbits and grouse if grazing should be stopped.

Area 82: Good habitat for grouse, both kinds of rabbits, and gray squirrels. The lower slope which was clear cut 5 years ago and contains many blackberry bushes and weeds is especially suited to grouse and rabbits. The older growth is 61 to 70 year old oak, maple and birch, with considerable hemlock and white pine, and has plenty of underbrush, wintergreen and *Viburnum*.

Area 83: Old field type containing witch hazel and thorn apple. It is slowly spreading into the surrounding open area.

Area 84: Good gray squirrel habitat with numerous 41 to 50 year old red and white oaks; suitable for grouse and snowshoe rabbits on the lower slope. There is much wintergreen and some shad bush.

Area 85: A stand of 41 to 50 year old oak and chestnut with much wintergreen and *Viburnum*, providing good conditions for grouse, snowshoe rabbits and gray squirrels.

Area 86: The all-aged beech, oak, maple and hemlock is fairly satisfactory for grouse and gray squirrels, while the western edge and the region about the opening to the west is a tangle of blackberry bushes, golden-rod and old apple trees—excellent habitat for birds and cottontails.

Area 87: A very dense 7 year old growth of hemlock and hardwoods (the latter including beech and black birch) makes excellent cover for grouse and snowshoe rabbits; there is also a generous quantity of blackberry bushes.

Area 88: Fairly good habitat for grouse and rabbits, with prom-

ise for raccoons in the 51 to 60 year old stand. Much partridge berry was noted, and, along the Run, hemlock and yellow birch.

Area 89: Old field type 0.5 stocked with thorn apple, soft maple, etc.; is fair grouse and cottontail habitat.

Area 90: All good grouse habitat, although of a composite nature. For 500 feet north of the Sawmill Run road the stand was cut off about 5 years ago, leaving the scattered hemlock. The hardwood coppice, hemlock and tangle of blackberry and raspberry bushes furnish protection and food for grouse. North of this division, sugar maple, beech and a little hemlock, aged about 50 years, has good undergrowth in the lower half, becoming more scant on the ridge-top, although still remaining fairly satisfactory for grouse. On the east, the stand is spreading into the pasture, and here there is much thorn apple, *Viburnum*, and some blueberry.

Area 91: The lower slopes are covered with an over-mature stand, including beech and some oak, and is excellent for gray squirrels. Raccoons can find den sites in the very large hollow trees, and the great amount of ground cover and brush makes excellent protection for grouse and snowshoe rabbits, as do the upper slopes which support a dense 5 year old coppice of beech, maple and oak. Considerable amounts of blackberry and raspberry bushes contribute to the food supply for bird life.

Area 92: Large scattered maples, oaks, hickories and tulip trees stand above an understory of these species in addition to beech, ash and witch hazel. Openings are rare. A few pines and hemlocks remain from the original stand. Approximately three acres, near the crest of the ridge, was clear cut about 5 years ago and here reproduction of cherry, maple and oak is very dense. The presence of much sumac, with the dense cover, makes this section especially suitable for grouse and snowshoe rabbits, but the entire area can be said to be fairly good habitat for these species.

Area 93: Has much hemlock, but relatively little undergrowth; nevertheless several signs of grouse were seen here.

Area 94: Fine grouse and cottontail rabbit habitat. It is old field type, the eastern side having a density of 0.7 to 1.0, the remainder being 0.5 stocked. The cover is composed of trembling aspen, pignut hickory and white oak. There is much thorn apple, in places forming impenetrable thickets; also much *Viburnum* and some blueberry and sumac. The area is well drained, probably becoming very dry in time of drought, and is good year round habitat for grouse.

Area 95: This area is under-stocked with 61 to 70 year old trees which include oak and hickory. The understory is dense enough to



provide cover for snowshoe rabbits and grouse, especially in the many openings caused by the removal of blighted chestnut. Food plants include *Viburnum*, blueberry and wintergreen.

Area 96: Has a young and very dense growth of witch hazel, hawthorn, blackberry, and young oak and maple coppice 4 to 6 feet high. The wild rose is scattered in small quantities throughout the area. The thick cover and the protection from north winds, make this place favorable for grouse and snowshoe rabbits. A few large oaks and maples provide food and retreats for gray squirrels and while this habitat is quite restricted at present, many red oaks of 6 to 8 inches D.B.H. will furnish a wider range in some years to come.

Area 97: Has a relatively large amount of underbrush for a rather dense young stand; and has much grouse food in *Viburnum dentatum* and scattered blueberry. There is no hemlock, but because of the gentle slope and dry exposure this is typical rearing ground for grouse. One adult was seen here and evidence of others (see figure 15).

*Subdivision 3 (Bone Run. Areas 98-130 inclusive).* Area 98: An ideal habitat for grouse, being a middle-aged stand of hardwoods in which there are plenty of openings, all filled with brush. Beech and oak are the principal food trees here, while thorn apple or *Crataegus* which has sprung up in the scattered openings provides both food and cover for small game. The thorn apple is also plentiful amongst the coppice and seedling reproduction which has followed the cordwood cuttings. Two grouse were flushed here.

Area 99: Excellent habitat for grouse. It provides additional cover to supplement that of area 98 although the upper slopes are open and probably much exposed in winter. The lower part, however, has considerable hemlock, as well as much undergrowth, which is principally beech.

Area 100: Excellent winter habitat for grouse and for both species of rabbit. Scattered hemlocks stand above a tangle of thorn apples, raspberry, blackberry and sumac, with oak and maple coppice. Partridge berry is present in quantities. A few oaks make conditions favorable for squirrels.

Area 101: Has fair cover, which is continuous with the good cover of the two succeeding areas. It is old field type, with much thorn apple, beaked hazel, oak, blue beech and maple, and some hemlock and beech. This is a fine habitat for grouse and cottontail rabbits.

Area 102: A hardwood stand of maple, hickory and beech, with plenty of undergrowth, providing good shelter for grouse and a fairly suitable habitat for gray squirrels. The western end of the area has considerable scattered beech and black birch, as well as much blackberry and a little red-berried elder and thorn apple, making conditions especially good for the ruffed grouse.

Area 103: An abandoned pasture now almost fully stocked with thorn apple, blue beech, ferns, sprout hardwoods, blackberry, raspberry, etc.

Area 104: An excellent habitat for grouse and cottontail rabbits. The area was cut over about 5 to 10 years ago. Hard maple coppice is very dense in places, but other openings are still covered with brush piles. Many scattered hemlocks provide good cover. *Viburnum* is abundant.

Area 105: Old pasture, rapidly becoming reforested with hardwoods and beaked hazel, and much thorn apple. It will provide good cover for grouse and cottontail rabbits in about 5 years, if the present use as pasture should be discontinued, while at present it is a good feeding ground for the ruffed grouse.

Area 106: Old growth hemlock and maple, the former providing well protected roosting places for grouse. Underbrush, however, is scanty. There is relatively little food for gray squirrels, although the locality may undoubtedly support a few.

Area 107: The stand here is 20 year old hardwoods too closely spaced to permit the development of undergrowth or persistence of the lower branches. Occasional large maple and beech trees make favorable den sites for raccoons. The pasture north of this area is reverting rapidly to hard and soft maples, witch hazel, chestnut, black birch, etc., with a fair amount of blackberry bushes. It is now good habitat for cottontails, and will become so for grouse in a few years.

Area 108: Excellent grouse habitat, having fine cover in the very dense hardwood coppice.

Area 109: This area was clear cut 3 to 4 years ago, and now has a rather scanty growth of hardwoods, but many raspberry bushes and weeds and a smaller quantity of blackberry and willow, making good small game cover in summer.

Area 110: The stand is of varying ages above 20 years but lacks underbrush. The large trees may very likely furnish some denning places for raccoons.

Area 111: Densely stocked with 5 year old maple, black birch, beech and an occasional hemlock; has an abundance of blackberry,

raspberry, and thimbleberry bushes. It is a fine grouse and snowshoe rabbit habitat.

Area 112: Has little undergrowth and little food for grouse, but the larger trees of the all-aged stand may be suitable for raccoons.

Area 113: Clear cut about 5 years ago and now has much hemlock, hard maple and black birch, as well as many patches of older reproduction. The openings contain many blackberry and raspberry bushes, and are of the kind which the black bear likes to frequent during August and September. This area as well as the following provides excellent grouse and snowshoe rabbit habitat.

Area 114: The young coppice and seedling stand contains witch hazel, much blackberry, golden-rod, *Viburnum* and wintergreen, with some blueberry bushes.

Area 115: This section has young mixed hardwoods which include black and yellow birches; also has much *Viburnum* and some partridge berry. Small hemlocks give additional cover, and the area may be rated as fairly satisfactory for grouse and snowshoe rabbits.

Area 116: A dense coppice in mixture with a little cherry, making a fine grouse and rabbit habitat.

Area 117: Fairly good habitat for snowshoe rabbits and ruffed grouse. Blueberry, huckleberry, *Viburnum*, wintergreen and partridge berry are abundant but the cover is rather more open than is desirable.

Area 118: A stand of 100 year old oak, chestnut, beech and maple, excellent gray squirrel and raccoon woods. For grouse there is cover in the heavy undergrowth but, except for some partridge berry, common food-bearing shrubs are scarce.

Area 119: Similar to area 117 but with less *Viburnum*.

Area 120: A fire about 25 years ago destroyed most of the ground litter, and this probably accounts for the present open stand of oaks. These at maturity will provide good habitat for gray squirrels. Wintergreen is very plentiful while *Viburnum* is abundant and blueberry and huckleberry bushes are common. The area is now a fair habitat for grouse, although the cover is somewhat deficient.

Area 121: A fine ruffed grouse, snowshoe rabbit and gray squirrel habitat. The main stand consists of 41 to 50 year old white and red oaks, with much hemlock over 100 years of age. Some of the hemlock has been recently cut and the slash provides more ground cover than does the present understory of maple, beech, witch hazel and hemlock.

Area 122: This area also provides suitable habitat for ruffed grouse and snowshoe rabbit. The young stand is composed of oak,

much large-toothed aspen, and, in the last valley to the east, hemlock, wintergreen and partridge berry are plentiful.

Area 123: Provides much food for ruffed grouse such as thorn apple and apple and has fairly good cover.

Area 124: Has no underbrush but provides some good nesting sites for the ruffed grouse.

Area 125: This area supports grouse at present. The cover is thick and there is considerable sumac and wild cherry, with some beech and *Viburnum*. Checkerberry is plentiful.

Area 126: The easternmost part, a long strip about 200 feet wide south of Area 127, provides excellent feeding ground for grouse. There is much thorn apple, some large-toothed aspen, rose, and scattered blueberry, huckleberry and dewberry; but the cover for grouse will become better with the further spread of the thorn apple. The western part of this area provides more cover, especially around the edges and among the scattered white pine and hemlock. A few cherry trees provide additional food. This area is also good habitat for cottontails.

Area 127: Rather open, having little underbrush, but with much attraction for grouse in the carpet of checkerberry. It is also raccoon habitat.

Area 128: Black and white oaks, maple, chestnut and large-toothed aspen, aged 41 to 50 years, are being removed, leaving openings in which there is good grouse cover, and food in the oaks, flowering dogwood, *Viburnum* and thorn apple. There are quantities of blueberry bushes (*V. pennsylvanicum*).

Area 129: The older trees have all been cut, leaving the cover in poor condition for game species.

Area 130: Has a good supply of food and a fair cover for grouse. The majority of the growth is 10 year old oak and hard maple, with much sassafras and witch hazel. Forty to fifty year old red and white oaks are scattered over this area. Checkerberry or wintergreen is very abundant.

*Subdivision 4 (North Branch Bone Run. Areas 131-182, inclusive).* Area 131: Has a fair amount of underbrush and the ground is almost carpeted with partridge berry. Logging roads are frequent, although there are no other openings. This is excellent habitat for grouse, and the large, hollow maples and beeches standing over the younger trees provide denning sites for raccoon.

Area 132: Good habitat for grouse, the cover along the streams being particularly suitable for all year round conditions.

Area 133: Occasional old maples provide den sites for raccoon. The main stand, however, is densely stocked with maple, hemlock, blue beech, beech and ash, but the lower slopes have more blue beech and much thorn apple, as well as many openings which contain some partridge berry and wintergreen. The area is suitable for snowshoe rabbit and ruffed grouse.

Area 134: Old field type, now densely stocked, providing good cover for rabbits and having much grouse food in the thorn apple and blue beech. On the lower slope, the openings have plenty of food-producing plants such as wintergreen, thorn apple and old apple trees.

Area 135: The valley bottom here supports younger growth than that further north, and is old field type, with some large openings filled with a rank growth of jewelweed, golden-rod, etc. The area is good habitat for ruffed grouse, woodcock and cottontail rabbits.

Area 136: Similar to area 133, with the exception of hemlock which is found here.

Area 137: This area was clear cut 10 years ago, and now supports a stand of blue beech, red and white oaks, hard maple, beech and hemlock, with considerable aspen and thorn apple. Blackberry bushes are plentiful and there is some wintergreen, partridge berry, *Viburnum* and shad bush. A few grassy openings combined with the other features make this a desirable habitat especially for grouse and snowshoe rabbits.

Area 138: Chiefly blue beech, with scattered older trees of various ages. Hemlock and white pine provide cover. The valley bottom is in places open and supports a thick growth of rank grass. The area is suitable winter habitat for grouse and rabbits.

Area 139: Clear cut 10 years ago, and now has a stand which includes blue beech, red and white oaks, hard maple and beech coppice, considerable aspen, and thorn apples. Most of the aspen and thorn apple will probably disappear, or at least cease to afford food and cover, in the next decade. Blackberry bushes are only occasional, but partridge berry, wintergreen, *Viburnum* and shad bush are abundant. Grass is luxuriant, although openings are small and infrequent. The area, therefore, is excellent for ruffed grouse and snowshoe rabbits.

Area 140: A good habitat for grouse, gray squirrels and snowshoe rabbits. Underbrush in the 41 to 50 year old hardwoods is plentiful, and the beech, black and red oaks and chestnut provide much mast.

Area 141: Contains plenty of young black and yellow birches,



on which grouse can maintain themselves in winter by budding, and also has much cover and food for the snowshoe rabbit. There is also beech, hemlock, and some partridge berry and *Viburnum*.

Area 142: A good rearing ground for grouse. There is much undergrowth, while large scattered beeches and oaks provide food for this species as well as for squirrels. Denning places suitable for raccoons very likely occur in some of the larger trees.

Area 143: Has fine cover, amounting to a tangle in places, in the lowest part of the valley along Mud Creek. Here are tall weeds and golden-rod, a few hemlocks and many old apple trees. In the upper part of the valley the old farm land is being reforested with thorn apple, bird cherry, blackberry, etc., providing fine food and cover conditions for grouse.

Area 144: Provides good raccoon and snowshoe rabbit habitat. Lack of undergrowth and of food plants, except beechnuts from scattered trees, would, however, limit the possible grouse population to a small number.

Area 145: The 80 year old and over stand, which includes beech, hemlock and hornbeam (good raccoon trees; and food trees for grouse), has been recently opened up by a heavy selection cutting; but the resulting reproduction and briars should furnish good cover for rabbits and grouse. The only grouse food plants on the forest floor are a small amount of partridge berry.

Area 146: Has some undergrowth and many ferns, and may be acceptable habitat to some species of small game.

Area 147: The all-aged upper cover, which includes beech and black birch, was opened in patches about 15 years ago, thereby making good game covert. Blackberry bushes are still present, but are being shaded out. The larger trees may contain cavities suitable for raccoon dens.

Area 148: An irregular young growth with strips and groups of a stand like that of area 147. The coppice provides excellent cover and there is much blackberry, making the area a good habitat for grouse and both species of rabbits.

Area 149: Has a considerable amount of undergrowth, with some *Viburnum*, and may be classed as grouse habitat. Beech, approaching fruitbearing age, will furnish considerable food.

Area 150: A good grouse habitat, having an 11 to 20 year old growth including chestnut, black birch and aspen, with a generous supply of *Viburnum* and wintergreen. Both snowshoe and cottontail rabbits find cover here.

Area 151: About one-half stocked with old beech, maple and hemlock, which provides acceptable raccoon habitat. The 11 to 20 year old understory shelters snowshoe rabbits and grouse. There is a considerable amount of *Viburnum* and wintergreen.

Area 152: A thick growth of 5 to 7 year old mixed hardwoods, including black birch and beech, has killed out all the blackberry and raspberry shrubbery, except in frequent small openings. There are also scattered pin cherry trees and, on top of the ridge, much *Viburnum* and some wintergreen. This is excellent grouse and snowshoe and cottontail rabbit habitat. Raccoons may find suitable dens in scattered cull trees left uncut from the previous forest.

Area 153: Good habitat for raccoons and fair for grouse. The 51 to 60 year old maple and beech forest has an understory of maple. *Viburnum* is growing here in relatively large quantities.

Area 154: A young stand of maple and aspen, with much wintergreen and some blackberry in the openings making this area a fair habitat for grouse and rabbits.

Area 155: Good snowshoe rabbit and grouse habitat. The 5 year old growth includes black birch and poplar, and there is much *Viburnum* and wintergreen and some partridge berry. Scattered hemlocks provide additional winter cover.

Area 156: Has a stand of 61 to 70 year old maple, beech and hemlock favorable for grouse and raccoon. Both *Viburnum* and wintergreen occur.

Area 157: The long valley bottom bordering the stream flowing east into the North Branch of Bone Run is forested with a mixed growth of blue beech, alders, yellow birch, etc. The ground is very moist and supports a rank growth of grass and weeds, but the density of the upper canopy prevents the formation of a true swale. The area is fairly good woodcock habitat, and is suitable for grouse in summer, but the ground cover is not thick enough to offer adequate winter protection.

Area 158: Both cover and food conditions are especially favorable for grouse on the ridge-top in this area. Partridge berry was noted, and wintergreen and *Viburnum* were abundant. Snowshoe rabbits can also find suitable habitat here. The east slope (the western half of the area) has a thinner undergrowth and fewer food plants.

Area 159: The 41 to 50 year old stand includes beech and an occasional hemlock. The ground cover is fairly thick in places, and some partridge berry, wintergreen and *Viburnum* are among avail-

able food sources for ruffed grouse. The area will also support raccoons and gray squirrels.

Area 160: Has excellent cover for grouse and rabbits in the 10 to 15 year old growth, most of which is coppice, and which includes black birch and a little willow and cherry. Weeds and blackberry bushes are thick on the site of the abandoned logging camp in the north central part of this division.

Area 161: This was cut over five years ago. Many saplings left at that time, in addition to coppice of witch hazel and sapling black birch, provide excellent cover for ground dwelling game. Grouse have much food in blueberry, wintergreen and Viburnum and other plants.

Area 162: Affords good habitat for grouse, snowshoe rabbits, raccoons and gray squirrels. The main stand, which includes oak and chestnut, is 51 to 60 years of age. A selection cutting 15 years ago has stimulated a heavy undergrowth of maple, oak, black birch and witch hazel, and there is a large amount of Viburnum, with some wintergreen and partridge berry. Blueberry bushes are present in the more open places, but have probably ceased bearing.

Area 163: A fairly good cover for grouse, with many food-producing plants such as blueberry, wintergreen and Viburnum. The 41 to 50 year old oak, beech and chestnut make favorable conditions for gray squirrels and raccoons.

Area 164: Cut over 5 years ago, leaving an excellent cover of dense reproduction. There is a great amount of blackberry, and some blueberry and wintergreen. The cover appears to be suitable for snowshoe rabbits and ruffed grouse and a large number of old scattered maples and beeches offer favorable conditions for raccoons and gray squirrels.

Area 165: Old field type of greatly varying density. The cover is witch hazel, black birch, blackberry, with a large apple orchard. Wintergreen is very plentiful on the west side of the road running through the area, and wild hops were found around the abandoned house. The area is a good small game covert.

Area 166: Excellent for grouse and for snowshoe rabbits. The cover is a very dense 6 to 8 year old growth which includes black birch, some cherry and an occasional hemlock. There are quantities of blackberry bushes and wintergreen in the openings.

Area 167: A heavy undergrowth is found over most of the area, in openings caused by the death of chestnut. The present stand of pure oak 21 to 30 years old will make good conditions for gray squirrels in the future. There is some partridge berry, wintergreen

and *Viburnum*, and sumac in the openings, which is attractive to grouse; and the thick cover will in addition afford habitat for both species of rabbits.

Area 168: Has little undergrowth of protection value to game but there is a thick ground cover of *Viburnum*, blueberry, wintergreen and other food plants. This area in the future should be capable of harboring many gray squirrels when its pure stand of red and white oaks reaches the fruiting age.

Area 169: Good habitat for the ground-dwelling game. The cover is good and there are some blueberry, wintergreen, *Viburnum* and other food plants.

Area 170: Furnishes acceptable food and other habitat conditions for ruffed grouse, raccoons and gray squirrels.

Area 171: Many 80 year old trees, which include beech and chestnut, and openings filled with slash and a rank growth of blueberry, with much partridge berry and considerable wintergreen and *Viburnum*, furnish suitable habitats for both ground and tree dwelling game.

Area 172: This area was cut over 3 years ago but many beeches and hemlocks were left, which now furnish good den trees. A thick growth of weeds, blackberry and raspberry affords both cover and food for small game.

Area 173: Has an old stand of beech, maple and hemlock, with a beech understory, and a considerable amount of *Viburnum*, with some partridge berry and wintergreen. Gray squirrels, ruffed grouse and raccoons would all find suitable conditions here.

Area 174: For raccoons and gray squirrels there remain many cull maples, beeches, etc., standing above a 3 year old coppice, in which raspberry, *Viburnum* and herbaceous weeds are thick.

Area 175: Little underbrush is found here but raccoon and squirrel habitat is furnished by old (part over-mature) beeches, maples and basswoods.

Area 176: Clear cut 5 years ago, this area has excellent cover for woodland small game. Black birch, wild black cherry and much blackberry are among the food producing plants.

Area 177: Fair grouse, squirrel and raccoon habitat, being all-aged forest in which beech and oak are prominent, with a fair amount of underbrush and plenty of *Viburnum* and ferns.

Area 178: A fine raccoon habitat, the stand being all-aged and having occasional very old trees, especially along the stream running through it.

Area 179: Similar to area 177, with the exception of oak in the

upper canopy. Both these areas are excellent for tree dwelling game.

Area 180: A poor game habitat having very little undergrowth and but few food plants.

Area 181: Clear cut 3 years ago, this area has, in addition to the hardwoods, much blackberry, raspberry, and "weeds" such as golden-rod. The cover is good for grouse and for rabbits especially in summer. Tree dwellers will find only a few remaining trees.

Area 182: Old field type stocked with blue beech, but suitable for game birds.

*Subdivision 5 (Phillips Brook. Areas 183-192, inclusive).* Area 183: A slash, which provides good protection for grouse. Partridge berry, Viburnum and cherry are abundant while blackberry and sumac are present in small quantity.

Area 184: Unsuitable for ruffed grouse, the stand being so thick that ground-cover is lacking. Partridge berry is present in small quantities on the lower slope, which would be suitable feeding ground only for grouse. Many large maples will doubtless provide denning possibilities for tree dwelling game.

Area 185: This area has little undergrowth and is poor territory for grouse or other ground dwelling game, although it contains a considerable variety of food producing plants.

Area 186: A good pheasant habitat in parts but too open for grouse. There is plenty of such cover as sumac, black birch, grasses and weeds. Partridge berry is not abundant, but in places there is much wintergreen.

Area 187: This area has little undergrowth and is not at present suited for any kind of game.

Area 188: Fairly good grouse habitat. Protection is afforded by the young hardwood sprout stand. There is considerable partridge berry and wintergreen, as well as some maple-leaved Viburnum.

Area 189: An all-aged stand, containing, among other species, hemlock and beech. Mast, as well as much wintergreen, some partridge berry and other plants, creates favorable food conditions. Many ferns were noted.

Area 190: An old field (density 0.7) containing neglected apple trees, thorn apple, blue beech, blueberry and blackberry. It makes an excellent place both for grouse and for cottontail rabbits.

Area 191: Five year old coppice growth, excellent for grouse and snowshoe rabbits. Fire or bird cherry will contribute to the bird food supply.

Area 192: The swale grass, willow, blue beech and birch of this



area should be excellent for cottontail rabbits; but much debris brought down by the brook perhaps provides good shelter for weasels.

*Subdivision 6 (Pierce Run. Areas 193-210, 212-220, inclusive).*

Area 193: This area is on the south side of Pierce Run, and except for scattered hemlocks was cut over 8 years ago, but now provides excellent cover. There is much food for the grouse in black birch, cherry, blackberry, raspberry and thimbleberry, as well as some partridge berry and wintergreen.

Area 194: This area is pastured and is wholly unsuitable for wild life, with the exception of muskrats, a few of which still inhabit Pierce Run.

Area 195: This area is also grazed, but less heavily. It is now about half stocked with birch, blue beech, hemlock and elm, and is good winter habitat for grouse as well as snowshoe and cottontail rabbits.

Area 196: A mixed stand of beech, maple, etc., in a two storied form; suitable for both tree and ground-dwelling species of game.

Area 197: This is similar to the preceding area except that while the stand is all of the older age class the undergrowth is very dense, so that as a habitat it is superior to area 196.

Area 198: An excellent area for grouse and snowshoe rabbits. The main stand is about eight years old and is composed of hard maple, cherry, blue beech and black and yellow birches. Older birch, hemlock and beech yield food and additional protection. Blackberry and raspberry bushes are abundant, but are probably ceasing to yield because of competition with the hardwoods.

Area 199: Fine winter habitat is provided for grouse and rabbits, as the cover is particularly good and the site is protected from winds. Blue beech, birch, and hemlock furnish shelter and food, while tangles of rank grass provide good cover in summer. Blackberry, raspberry and thimbleberry bushes are numerous.

Area 200: This area evidently supports a very few snowshoe rabbits, as signs were noted twice, but conditions are generally unfavorable.

Area 201: Due to the absence of undergrowth, this area is not promising for ground dwelling birds or mammals. Large scattered hard maples and beeches would suggest a few resident gray squirrels and raccoons.

Area 202: The area west of the opening is old field, which in places becomes quite dense with hard maple and sweet cherry. It is

good grouse and cottontail rabbit area, although small in extent.

Area 203: This area is without underbrush and is poor habitat for game.

Area 204: A good covert for ruffed grouse as well as for tree dwelling game. There is plenty of food in the form of beech and oak mast, while on the outskirts there is much poplar and thorn apple, providing protection and food for pheasants as well as for the native game bird. Among the five year old sprout hardwoods are remnants of the original stand in many hollow beeches and maples, which furnish good den sites for raccoons and gray squirrels. The field close by has a large supply of trailing dewberry.

Area 205: The stand is somewhat younger than 40 years and has sufficient underbrush to make it good grouse area.

Area 206: There is little undergrowth, but some 41 to 50 year old beech might form a nucleus for a grouse and gray squirrel habitat.

Area 207: Old field type, almost fully stocked with maple, black birch, beech and sumac. There is much partridge berry and some raspberry. It is good grouse and pheasant habitat.

Area 208: The stand includes old oak and would be attractive to gray squirrels and raccoons. The undergrowth, with *Viburnum* and wintergreen, indicates satisfactory food conditions for grouse.

Area 209: A young and very open growth, chiefly of red oak, is found here. Alone, it is insufficient for small game needs.

Area 210: Gray squirrels and raccoons would find an excellent habitat in the 71 to 80 year old oak, but there are also satisfactory conditions for ruffed grouse.

Area 212: The area is now too open and devoid of cover for game purposes but, as the majority of the trees are white and red oaks, there are possibilities at least for squirrels in the future.

Area 212a: A two-storied mixed hardwood stand with a few hemlocks; the younger age class being 21 to 30 years. Underbrush is present in fair amount, and provides fairly good cover. Beech is prominent in places and a great amount of oak means food for certain small game species. The area is also suitable for raccoon.

Area 213: A 0.7 stocked old field, of hardwoods such as hickory and cherry, with much wintergreen, making conditions favorable for grouse and cottontail rabbits, and also for pheasants.

Area 214: A 20 year old mixed hardwood stand with plenty of underbrush. Partridge berry and wintergreen are plentiful. A good habitat for woodland small game.



Fig. 13. Maple-leaved Viburnum or Arrow-wood (*Viburnum acerifolium*).



Fig. 14. Grouse habitat in area 104 (on the south slope of Bone Run). A dense growth of sprout hardwoods, berry briars, etc., provides excellent food and cover. A flock of about 12 birds was flushed at this point. This is also an illustration of Upland Thicket habitat (see page 115).





Fig. 15. Grouse rearing ground in young mixed hardwoods on the ridge north of Onoville.



Fig. 16. A grouse dusting-place in Browns Run.



Area 215: Former old field with trees of various ages, now fully stocked with poplar, maple, blue beech and cherry; excellent for woodland small game.

Area 216: A good grouse and snowshoe rabbit area. Protection and food are afforded by 5 year old coppice, which includes blue beech, and seedling birch. Scattered older hemlocks occur.

Area 217: This area is older, but otherwise food and cover are much the same as in area 216.

Area 218: Clear cut 10 years ago, this area now has the appearance of old field type about 0.8 stocked. In addition to hardwoods there is blackberry, raspberry, dewberry, thimbleberry and some blueberry. Beech forms dense thickets in some places. This is one of the finest ruffed grouse habitats found in the tract and is also suitable for both snowshoe and cottontail rabbits.

Area 219: Chiefly old field type with much cherry, sumac, blue beech, wintergreen, and some thorn apple. The hilltop has an understocked stand of maple, oak and beech, left very open by the death of the chestnut. Pheasants occur here, in addition to ruffed grouse and rabbits.

Area 220: An all-aged stand of mixed hardwoods, including beech, with a fair amount of underbrush. This is good habitat for all our woodland small game.

*Subdivision 7 (Hotchkiss Hollow and North to North Boundary of Tract and Division II. Areas 211, 221-266, inclusive).* Area 211: This is old field type and when more fully stocked will doubtless provide good cover for pheasants.

Area 221: This area was clear cut about 5 years ago. Besides the hardwood reproduction—not dense anywhere—there is a fair amount of blueberry and raspberry. It is good habitat for woodland small game.

Area 222: The stand of 31 to 40 year old oak, ash, maple and beech has been opened up by cuttings, and hard maple reproduction is very dense. There is much partridge berry, and conditions are favorable for ruffed grouse, squirrels and snowshoe rabbits.

Area 223: The only possibility for game here seems to favor raccoon, although the largest trees (maple, beech and cucumber) are hardly of attractive size.

Area 224: There is but little promise for game in this area. The stand is composed of even-aged saplings, too dense for undergrowth or for the persistence of side-branches. Some partridge berry was noted.

Area 225: An all-aged forest, including in its composition beech, hemlock and cherry. Cutting has proceeded in patches and here reproduction, chiefly of hard maple, is dense and affords cover for grouse. The older trees would doubtless prove attractive to raccoon.

Area 226: A stand of varying ages which includes beech and a little hemlock. There is some wintergreen and blueberry, and the area should prove good grouse and squirrel habitat.

Area 227: Old field almost completely stocked, and with some old hemlock near the corner of the Hotchkiss Hollow road. The area is good habitat for both species of rabbits, and, while there is little food for grouse, the cover is of the best.

Area 228: A dense growth of hardwoods, including yellow birch, beech, hemlock and cherry occupies this area, but the undergrowth is not thick enough for protection to ground dwelling game.

Area 229: An excellent area for the tree dwelling mammals. Patches of old red and white oaks stand above the younger trees. There is relatively little underbrush, but plenty of certain game food, such as wintergreen, *Viburnum* and partridge berry.

Area 230: The 21 to 30 year old stand, which includes blue beech, birch and beech, has a considerable amount of partridge berry, but the underbrush is too scanty to furnish satisfactory cover for ground dwelling game.

Area 231: An all-aged growth of red and white oaks, hemlock, beech, birch and a little white pine. Undergrowth (encouraged by the practice of selection cuttings), much partridge berry, and patches of wintergreen, make the area a very favorable one for our small woodland game species.

Area 232: The forest, although of lesser age, has the same composition as that of area 231. The ground cover is good, and there is plenty of partridge berry and wintergreen. It is a good ruffed grouse and snowshoe rabbit habitat.

Area 233: Excellent cover and plenty of blackberry, raspberry and thimble berry are found in this area. It was cut over, except for scattered patches of hardwoods and hemlocks, five years ago and is now a thick tangle of maple and black birch.

Area 234: An old stand of mixed hardwoods, including oak which would afford food for a considerable squirrel population. The brush cover is good and there is some partridge berry and *Viburnum*. In addition to the smaller woodland game found here, the remoteness of this forest from man and his works indicates the possibility that black bear may occur here, or would find conditions satisfactory if introduced.

Area 235: Excellent woodland game cover is found in this area. The lower part is 5 year old coppice, grading into a mature stand of beech and maple which forms over half of the cover of the upper slope. There is some *Viburnum* and partridge berry, and there is considerable blackberry, raspberry and hemlock on the lower slopes.

Area 236: A 0.7 stocked old field which is good habitat for both grouse and snowshoe rabbits. Hazel, blue beech and witch hazel are the woody species of shrubs most important for grouse and there is in addition considerable blueberry, raspberry and wintergreen.

Area 237: Fairly large oak and chestnut trees occur which may be suitable for raccoons and squirrels. The stand is very open and there is little thick undergrowth, yet considerable quantities of such food bearing plants as *Viburnum* and wintergreen suggest good summer range at least for grouse. But as winter range there is inadequate protective cover.

Area 238: A narrow strip of this area on the south side of the open field of Jones Hill supports fine patches of sumac and thorn apple, and would constitute a good pheasant range as well as a feeding ground for ruffed grouse.

Area 239: This area is favorable for both grouse and pheasants. It is partly abandoned pasture about 0.8 stocked with hickory, beech, maple, oak and chestnut, with plenty of raspberry and blueberry, which grades into a 41 to 50 year old mixed hardwood stand.

Area 239a: A middle-aged stand, including hickory, oak and hemlock. The ground cover is fairly dense, with a large amount of *Viburnum*. It is a good grouse and squirrel habitat.

Area 240: A two-storied forest, principally seven years of age, including oak and much beech. Some raspberry and wintergreen is present. It is principally grouse and snowshoe rabbit habitat.

Area 241: A mature stand containing oak and other species. Excellent for gray squirrels and raccoons but the area has also sufficient low cover to furnish suitable conditions for grouse.

Area 242: Clear cut 5 years ago, this area now includes as cover, birch, beech, witch hazel, and raspberry and blackberry bushes and is excellent range for both species of rabbits as well as summer range for ruffed grouse.

Area 243: The stand of large timber, which includes beech and hemlock, was opened up about three years ago by a windstorm, and these openings now support a dense reproduction and a dense growth of ferns. It is a very good woodland game habitat.

Area 244: A fair grouse habitat.

Area 245: Suitable for both tree dwelling and ground dwelling small game.

Area 246: A good grouse and rabbit habitat.

Area 247: Sparse cover and relatively few food bearing plants. Unsuitable as game habitat.

Area 248: Satisfactory for ground dwelling woodland small game.

Area 249: Insufficient cover and food for game needs.

Area 250: This area was cut over 5 years ago and since then most of the chestnut coppice has been killed by the blight. The resulting opening up of the upper cover has encouraged a dense growth of blackberry bushes, etc., which has provided both food and cover for ground dwelling game.

Area 251: Lacks undergrowth, due to grazing, and is of little value for game purposes, in present condition.

Area 252: This area is quite similar to area 250 in that the death of the chestnut has promoted a dense ground cover, which includes blackberry, raspberry, wintergreen, blueberry, *Viburnum*, some partridge berry, and sumac.

Area 253: The stand consists of a dense 10 year old coppice growth of maples and chestnut. Blackberry, blueberry, wintergreen and *Viburnum* are abundant, and partridge berry vines are plentiful under the scattered 31 to 40 year old red and white oaks, making excellent habitat for small ground dwelling game.

Area 254: A small, practically abandoned pasture, 0.8 stocked with witch hazel, hickory, chestnut and a little thorn apple. There is a good supply of wintergreen, *Viburnum*, blueberry and other food producing species, so that the area has possibilities as a pheasant range.

Area 255: Most of this section was cut over 3 or 4 years ago. There is a dense growth of hard maple, plenty of raspberry and blueberry, and some wintergreen, so that conditions are favorable for ground dwelling woodland game.

Area 256: The swamp-like lower part is pastured, but is almost covered with ferns and contains a block of 31 to 40 year old red maple. The higher part of the area is forested with a dense sapling growth, the openings in which contain a considerable amount of raspberry, blackberry and wintergreen. This division is suitable for both grouse and pheasant range.

Area 257: A little cherry and hemlock are found here, but the absence of underbrush would render it unattractive to the usual small game animals.



Area 258: Suitable especially for raccoons and gray squirrels. The stand is about 80 year old maple, beech, ash, chestnut and hemlock.

Area 259: This abandoned pasture area is almost overgrown with witch hazel, hickory and other species and there is much winter-green and some *Viburnum*. It is suitable range for both woodland and marginal species of small game.

Area 260a: Good grouse and rabbit habitat.

Area 260b: There is no cover on this area, but much food for upland game birds.

Area 261: Good gray squirrel and raccoon habitat, but cover and food for other small game is lacking.

Area 262: Although clear cut 5 years ago, the resulting coppice growth affords good cover for grouse and rabbits. Much winter-green, *Viburnum*, blueberry and blackberry are among the food-producing species.

Area 263: This old field type is still used as pasture and affords good pheasant range.

Area 264: This area is used as pasture, although much of it is either wooded or covered with dense masses of ferns. The small patches of trees have little undergrowth, but the ferns provide cover for cottontail rabbits.

Area 265: The 11 to 20 year old stand is dense and provides good cover for small game; it includes beech and black birch, and there is some wintergreen and partridge berry.

Area 266: Although cut over 2 years ago, very little reproduction has been able to establish itself on this area. The ground is covered with a rank growth of weeds, including jewelweed and smartweed, and could serve as a feeding range for some species of small game.

**Division II: Habitats principally unforested.** Area 267: A strip through the middle of the area and running up and down the slope, taking in about half of the surface, was clear cut 3 or 4 years ago. It now supports hardwood coppice with some *Viburnum*, blackberry and wintergreen. The uncut portions include chestnut and oak trees which are about 41 to 50 years of age; excellent for gray squirrels.

Area 268: This area is open to grazing and has no underbrush; hence is worthless for game purposes.

Area 269: This old field type is 0.8 stocked with thorn apple and thickets of beech and soft maple. There is much wintergreen and some partridge berry. The area is excellent grouse range.

Area 270: Very open, and unsuitable as game habitat.

Area 272: Excellent covert for grouse is provided by the 8 to 10 year old chestnut and beech coppice, and birch and aspen seedling stand, while quantities of wintergreen, partridge berry and *Viburnum*, etc., contribute to the food supply.

Area 273: The abandoned pasture now supports an all-aged stand, including beech and oak, which provides an excellent habitat for gray squirrels. But there is also good cover and food for ruffed grouse.

Area 274: An excellent ruffed grouse habitat that has been ruined by sheep grazing (see Fig. 35). Were the grazing to be stopped the area might in time develop into satisfactory game habitat, for the upper cover is of the best.

Area 275: Excellent food and cover for both grouse and pheasants is found in this area. There is much sumac, bird cherry, raspberry, wintergreen, and some partridge berry. The stand is young (21 to 30 years) and quite open. The presence of the gray squirrel was noted.

Area 276: This is a very irregular area, most of it covered with dense growths of ferns. The wooded section also contains many ferns, and some wintergreen and partridge berry. It is good habitat for both kinds of rabbits. In the northern part is a sugar orchard in which is found good raccoon habitat.

On Battle Creek, between this area and the road to the east, there is a small muskrat habitat, where two burrows and runways were noted on August 7. Although this was just after a rainy period, there was but little water in the creek. The ground here is rough and the rank grass is not cut for hay. Even in dry seasons it may be that this spot does not entirely lose its marshy character.

Area 277: An area much varied and broken in composition. Small pastures within the area and spots along the opening on the eastern side are seeding in to hemlock; they also contain great beds of ferns, which provide cover for some small game species. There is good covert for grouse, especially in the pine plantation on the west side of the brook flowing north through this area.

Area 278: This is a "sugar bush", which has no undergrowth and is not suitable for game.

Area 279: Most of the area is being grazed and is therefore rather open and unsuitable for game under present conditions, except, perhaps in the northern half, where underbrush exists.

Area 280: This area was cut over under the selection system 3 years ago. The openings are being reforested with maple and birch

reproduction besides blackberry and raspberry bushes, and constitute good range for grouse.

Area 283: A hemlock understory and other underbrush, besides considerable amount of down timber, provides suitable cover for grouse.

Area 285: A good habitat for grouse, raccoon, snowshoe rabbit and gray squirrel.

Area 286: Now used for pasture, part of which is overgrown with maple, beech, white pine, hickory and hemlock. Although rather open at present, if grazing should be discontinued this would doubtless develop into a good habitat for ground dwelling woodland small game.

Area 287: Excellent habitat for raccoon and gray squirrels, and fairly good conditions for ruffed grouse.

Area 288: An old pasture now supporting a 0.4 stand of thorn apple. It is at present suitable for pheasant range and in time might be developed into a satisfactory grouse range.

## LIST OF PLANTS MENTIONED IN DESCRIPTION OF FORESTS AND HABITATS

White Pine	<i>Pinus Strobus</i> L.
Red Pine	<i>Pinus resinosa</i> Ait.
Scotch Pine	<i>Pinus sylvestris</i> L.
Hemlock	<i>Tsuga canadensis</i> (L.) Carr.
Willow	<i>Salix</i> sp.
Trembling Aspen	<i>Populus tremuloides</i> Michx.
Large-toothed Aspen	<i>Populus grandidentata</i> Michx.
Butternut	<i>Juglans cinerea</i> L.
Shagbark Hickory	<i>Carya ovata</i> (Mill.) K. Koch.
Pignut Hickory	<i>Carya glabra</i> (Mill.) Spach.
Hornbeam	<i>Ostrya virginiana</i> (Mill.) K. Koch.
Blue Beech	<i>Carpinus caroliniana</i> Walt.
Black Birch	<i>Betula lenta</i> L.
Yellow Birch	<i>Betula lutea</i> Michx. f.
Alder	<i>Alnus</i> sp.
Beech	<i>Fagus grandifolia</i> Ehrh.
Chestnut	<i>Castanea dentata</i> (Marsh.) Borkh.
White Oak	<i>Quercus alba</i> L.
Chestnut Oak	<i>Quercus montana</i> L.
Red Oak	<i>Quercus borealis</i> L.
Black Oak	<i>Quercus velutina</i> Lam.

American Elm	<i>Ulmus americana</i> L.
(Common) Smartweed	<i>Persicaria Hydropiper</i> L.
Cucumber Tree	<i>Magnolia acuminata</i> L.
Tulip Tree	<i>Liriodendron tulipifera</i> L.
Sassafras	<i>Sassafras variifolium</i> (Salish.) Ktze.
Witch hazel	<i>Hamamelis virginiana</i> L.
Apple	<i>Pyrus Malus</i> L.
Shad Bush or Service Berry	<i>Amelanchier canadensis</i> (L.) Medic.
Thorn Apple	<i>Crataegus</i> sp. (see Fig. 7)
Red Raspberry	<i>Rubus idacus</i> L.
Thimbleberry	<i>Rubus odoratus</i> L.
Blackberry	<i>Rubus allegheniensis</i> Porter
Dewberry	<i>Rubus villosus</i> Ait.
Rose	<i>Rosa virginiana</i> Mill or <i>R. humilis</i> Marsh.
Wild Black Cherry	<i>Prunus scrotina</i> Ehrh.
Choke Cherry	<i>Prunus virginiana</i> L.
Bird or Pin Cherry	<i>Prunus pennsylvanica</i> L.f. (see Fig. 8)
Sweet Cherry	<i>Prunus avium</i> L.
Sumac	<i>Rhus</i> sp. (see Fig. 9)
Striped Maple	<i>Acer pennsylvanicum</i> L.
Mountain Maple	<i>Acer spicatum</i> Lam.
Sugar Maple	<i>Acer saccharum</i> Marsh.
Red Maple	<i>Acer rubrum</i> L.
Jewelweed	<i>Impatiens pallida</i> Nutt. and <i>I. biflora</i> Walt.
Basswood	<i>Tilia americana</i> L.
Flowering Dogwood	<i>Cornus florida</i> L.
Wintergreen	<i>Gaultheria procumbens</i> L. (see Fig. 10)
(Black) Huckleberry	<i>Gaylussacia baccata</i> (Wang.) C. Koch.
Blueberry	<i>Vaccinium</i> sp. (see Fig. 11)
White Ash	<i>Fraxinus americana</i> L.
Partridge Berry	<i>Mitchella repens</i> L. (see Fig. 12)
Viburnum	<i>Viburnum acerifolium</i> L. (see Fig. 13)
Golden-rod	<i>Solidago</i> sp.

## THE STATUS OF THE WILD LIFE

The data on the status of the various forms of wild life in this tract were acquired largely by the author during his summer's field studies there, but they have been considerably supplemented by information from people who have either lived or hunted, or both, for years within the area and who are, therefore, in many



ways better informed in regard to the wild life of the region than is the author. Residents especially are familiar with the local past history of many animals in their locality, and the writer wishes here to acknowledge his indebtedness to all those who have contributed from their knowledge and experience and thus done much to fill in many gaps in his own observations and findings.

The discussion following later of the various species of game and other animals found on the tract is supplemented by four maps. Map 3 shows their distribution as actually found by the writer. Symbols have been used to indicate the spot where each individual or group, or signs (droppings, tracks, partly consumed food, den or nest, etc.) of their recent presence were noted. The number of individuals seen at any spot, if more than one, is shown by a number accompanying the symbol. Maps 4, 5 and 6 indicate the distribution of these animals within the tract and are based on actual observations by the writer and on information given by residents. Maps 4 and 5 pertain to the larger mammals, Map 6 to the game birds.

The writer feels that it is not the purpose of this report to present a full and detailed life-history of each species discussed, for this information can be found elsewhere. Nevertheless, a report on the game and other animals of an area should convey a picture of local conditions as they affect this wild life, and that is what this discussion will attempt to do. Should a classification of habitats be attempted for those species occurring in the tract which are of chief popular interest either as game or fur animals, the following divisions may be recognized. Some species, as the porcupine, are but rarely found outside their particular habitat. The skunk and the woodchuck on the other hand represent species members of which may be found dwelling in distinctly different types of habitat, some individuals preferring open fields, others, forests. Other wide ranging mammals such as the white-tailed deer may be found in places widely differing in certain respects. The various species are here assigned to the habitat or habitats in which they most frequently occur.

*Forest Trees.* This classification only includes trees in closed stands or those bordering small natural openings. The mammals spending all or a considerable part of their time in the trees may live in the branches or perhaps have their dens in the larger branches or the boles. Most of these, however, take to the tree for shelter and protection, but otherwise spend much of their time on the ground. Food also may to a greater or less degree be secured in

the trees, but frequently, as in the case of squirrels, much of this not needed for immediate consumption is stored on or in the ground. Larger mammals of this habitat include such species as opossum; raccoon; gray, red and fox squirrels; and porcupine. Among birds, the ruffed grouse in winter often spends considerable time in certain trees, feeding on buds.

*Forest Floor.* The ground beneath the stand is the habitat for many species of wild life which may or may not be able to climb or do not fly about chiefly in the branches, but which spend all or a major part of their lives on the ground. Some species may resort to deep woods, not from choice, but from fear of man. The panther, though not present in the tract, is an example of an animal that finds better hunting conditions in younger and more open growth, but may be forced by its enemy, man, to seek the deep woods in order to find concealment. The raccoon, on the other hand, finds the large hollow trees required for his needs only in old timber; he may journey into the open on foraging expeditions, but returns to his woodland home. The forest was once, before the coming of the whites, the habitat of the eastern woodchuck, and still remains the home for many individuals, but others have found conditions to their liking in open fields. Among the more familiar species of wild life in the forest floor habitat are the following: bobcat, red fox, skunk, black bear, raccoon, woodchuck, porcupine, deer, and the ruffed grouse.

*Shade Trees.* In this category are included scattered trees whose crowns are proportionately larger than those of trees in the forest. These may be such as have been planted for shade purposes, or may have been left standing when the forest was cut off, as along roads or fences, and in pastures and open fields. The list of the mammalian species that may frequent such trees is limited usually to the gray, the fox and the red squirrels.

*Streams and Stream Margins.* Some animals that spend much of their lives along streams may have their dens in the banks or in masses of drift, etc., while others find much of their food in the water or along the margins. All of these, except the house rat (which more generally prefers the easier living closer to man's habitations), are fur-bearers and in most localities are hunted because of the value of the pelts. The list includes such species as mink, otter, weasel, raccoon, beaver and muskrat.

*Open Fields.* Some animals have, since the settlement of the country, been obliged to adapt themselves more or less to changed conditions and now depend, to a greater or lesser extent, on man

for their food. Such animals as the woodchuck, for example, have been very successful in establishing themselves in the vicinity of buildings and in open fields, or in hay lots where they are surrounded with foraging territory of the most acceptable kind. The woodchuck of such places, therefore, is often a far different individual from his brother of the woodland, being fat, sleek, slow and waddling, as compared with the more gaunt, alert and active ground hog of the forest habitat. The white-tailed deer, while in no sense deserting the protection of its forest cover, has also been quick to take advantage of the increased marginal foraging facilities offered by land clearing activities of man, and here may often be seen boldly out in the open. In some sections of the country it has likewise learned that the vicinity of man offers added safety from its natural enemies.

Among the more familiar examples of the open field habitat may therefore be mentioned the white-tailed deer, the skunk, the woodchuck, the cottontail rabbit, and the pheasant.

*Marsh and Stream Thickets.* Several species of wild life find protection from man, as well as food and shelter, in thickets in marshes or in boggy valley-bottoms along streams. These species include: mink, weasel, muskrat, pheasant, woodcock, cottontail rabbit, etc.

*Upland Thickets.* Due to the great amount of food such as buds, tender bark and twigs as well as the fruits of herbaceous and woody plants which are encouraged by removal of dense shade, this is an excellent habitat for the important species of wild life mentioned below. The term "Upland Thickets" includes all patches of scrub growth (such as occur in fence corners and other waste places), young coppice (sprout) and seedling reproduction on cut-over forest land, found on any soil outside of typical swamp areas. Due also to the dense growth, many animals find good shelter from weather, as well as protection from certain natural enemies. Examples of species that may be found in this habitat, as transients or as permanent residents, are black bear, woodchuck, snowshoe rabbit, cottontail rabbit, white-tailed deer and ruffed grouse.

*Ridge-top.* Where it has better winter cover this may be the permanent habitat of some of the species mentioned for the Upland Thicket, e.g., the white-tailed deer, the snowshoe rabbit, the bobcat, the red fox, the raccoon, and the black bear; and among game birds, the ruffed grouse.

**Game, Fur-bearing and other Mammals.** *Wildcat.* The wildcat or bay-lynx may occasionally inhabit the tract. No signs of its

presence were found by the writer, but the following testimony would indicate its rare occurrence.

Mr. Pickup has never actually observed any wildcats in the tract, although he thinks that individuals may occasionally occur. Mrs. Mearle Wheeler of Bowen stated, however, that a friend had heard what was believed to be a bobcat, in the region of Mud Creek and North Branch Bone Run Valley, a few years ago. Dr. Hawley, during many winters, had seen occasional tracks in the district between Vollandine and Steamburg, but he believes the animal to be scarce.

*Red Fox.* According to testimony, foxes are common in the tract. Mr. Paul Moore of Pierce Run places the average annual catch in the township of South Valley at twelve. Mr. Fred Seitz, of Onoville, a man said to be particularly well informed on game matters in this township, places the number at fifteen. According to Mr. Howard Robbins, the animals are "abundant" in the southwest portion of the tract, and a large number den in the locality just west of the county line, between the Brown Run road and the South Branch of Sawmill Run.

The fox probably destroys more wild life of the tract than does any other mammal. Dr. Hawley of Randolph believes the fox to be "the limiting factor of most game," and has often found grouse killed by it. Mr. Pickup, judging from the bone remains he had noted in the vicinity of fox dens, believed that the number of grouse and of rabbits taken were about equal. He had also observed that in winter it was quite common for grouse buried in the snow to be caught and devoured by foxes. The habit of the fox on such occasions is first stealthily to locate the unsuspecting bird by moving in a circle and "winding" it, but never approaching closer than 7 or 8 feet. He then makes a leap and almost invariably lands directly upon the bird although it may have been entirely concealed under new-fallen snow. Mr. Pickup believes that the fox generally prefers rabbits to grouse. Mice, according to the testimony, are numerous in the tract, but to what extent they enter into the diet of the fox was not known. Signs of fox were noted on the ridge-top of area 89, and on the Braley Hill road near the top of Pierce Run slope. Other signs believed to be of fox were more plentiful on the west slope of Pierce Run.

*Mink.* Mink were said to have been practically trapped out of the streams of the tract, and because of its scarcity, destruction of game by this agency is at present negligible. Mr. Fred Saxton stated that to the best of his knowledge only three mink were caught





Fig. 17. Pheasant habitat on the edge of a field south of Bowen. Sumac and cherries store a small quantity of food for winter.



Fig. 18. Mink and weasel habitat on Sawmill Run.



Fig. 19. A raccoon den-tree in Sawmill Run, felled contrary to law in an attempt to reach the animal. The trunk of the tree lies on the ground at the right of the stump.



Fig. 20. Woodchuck burrow in a field near Bowen.



in the vicinity of Onoville during the winter of 1925-26. He considered the animal rare, and believed that not over a dozen individuals of the species live in Sawmill Run and its branches, in the general neighborhood of Onoville. Other persons whose combined experiences fairly well cover the entire tract also considered the mink generally scarce.

*Weasel.* Although few signs of weasel were actually observed in the tract, indications were that they are common. All persons interviewed in the southern division of the tract agreed that they are plentiful in that territory. The only person interviewed in Division II was Mr. Harold Walters of Sample Hill, who expressed the view that weasels in his vicinity are only "fairly numerous."

The tangle of débris found in the North Branch of Sawmill Run (see Fig. 18) would suggest a favorable situation for the weasel as well as for the mink. Several men who have hunted much in the tract, considered the weasel especially effective in keeping the numbers of small rodents within bounds. Mr. J. R. Schrader believed the weasel to be the greatest enemy of the rabbits. Mr. Paul Moore of Pierce Run said he had seen many instances of cottontail rabbits killed by it, but no other game. He emphasized especially that he had seen no snowshoe rabbit killed by the weasel, although many believe it frequently to be a victim. In ordinary circumstances it is hardly justifiable to advocate reduction of the numbers of the weasel, since an overproduction of field mice and similar small rodents is always a possibility to be considered.

*Skunk.* Skunks ordinarily prefer open country and agricultural land where small clumps of trees or brushy areas are plentiful. As was therefore to be expected, skunks were more plentiful in Division II than in Division I. Dr. Hawley and Mr. Harold Walters believe that these animals are rather abundant in the northern part of the tract adjacent to Randolph village. Howard Robbins, living near the Browns Run road at the point where it crosses the county line, says that they are very abundant in his vicinity, which has much open land especially to the west in Chautauqua County. Mr. Harry Moore of Pierce Run states that skunks are only fairly common in his neighborhood but abundant in the open areas at the head of Pierce Run. In the vicinity of Onoville, however, Mr. Fred Saxton thinks that skunks are not plentiful, and adds that during the winter they move into the timber for protection. He has never seen any evidence that they molest grouse or their eggs or young.

*Black Bear.* Judging from direct observations and from testimony bears are not uncommon in the tract, usually keeping, of course, to the more heavily wooded sections, but occasionally appearing on the farms. Mr. Leone Pickup relates that a number of years ago, when cover was thicker on the hills south of Randolph, he saw the track of a bear at the Randolph Reservoir, about a mile beyond the village limits. In recent years the animals have not ventured into this locality, especially since lumbering opened up the country, although it is said not to be uncommon to see them in the fields and woods east of Vollentine. Mr. Pickup believes that bear are increasing, due, probably, to the increase of suitable cover.

Harold Walters has seen tracks at various times while hunting in Phillips Brook and in the North Branch of Bone Run.

A sawyer at the mill of D. A. Ostrander in Hotchkiss Hollow stated that on August 3rd a large black bear was seen eating berries at the edge of the woods on the south slope of the Hollow, just east of Braley Hill road.

A bear was started by the writer on June 30, in a very dense slashing near the crest of the hill south of Bone Run, at a point about opposite the Phillips Brook road. A little west of this, in the western end of area 107, a log was found clawed to pieces by bear in search of ants, grubs, etc.

Members of the Coulter family, living near the Bone Run School, stated that in the fall bears often climb the apple trees in their orchard situated about 400 feet north of their house.

Mr. Wilford A. Dence of the Roosevelt Station Staff saw considerable fresh evidence of bears, such as clawed logs, etc., in the western branch of the North Branch of Bone Run, on July 15.

In area 233 in Hotchkiss Hollow, it was noted, August 3, that raspberry bushes were much trampled, suggesting the presence of bears.

Mr. Richard Johnson, living within the tract northeast of Ivory, stated that he saw a large bear, about August 20, at the east edge of the clearing in which his house is situated.

Mr. Moore of the North Branch of Sawmill Run, immediately west of the county line, and Mr. Howard Robbins of Browns Run stated that bears are "often" seen in this section of the tract.

*Raccoon.* Judging from the signs observed, this valuable furbearer is widely distributed in the tract and in some localities would appear to be plentiful. In the Vollentine-Bowen and Sample Hill localities alone was there noted any lack of suitable habitat. Testi-



mony of residents confirmed the conclusion that the status of the raccoon is very satisfactory, although in the northern part of the tract Mr. Leone Pickup considers their numbers less than they were four years ago, a result of much hunting and trapping. In contrast is the vicinity about Onoville, where Mr. Saxton says they were scarce four years ago, but now plentiful, especially in the big timber on the ridge-tops. According to Mr. Floyd Whelpley, an especially favorable raccoon habitat is found in the area between Browns Run and the South Branch of Sawmill Run.

It was of interest to question residents in regard to the popular belief in the trout catching activities of the raccoon, but most of the persons questioned, while they had no adequate proof for their beliefs one way or another, expressed the opinion that trout caught by raccoons are few—secured by accident—and that the trout, because of its superior speed and alertness, is able to elude predatory mammals generally unless impounded in a shallow pool by subsiding water. However, that the raccoon will eat fish when able to catch them is certain. Mr. Henry Swanson of Mud Creek told me that several years ago, while fishing in a small stream near his home, he actually saw a raccoon catch and eat a fish. He believes this fish to have been a trout, but he has no proof. Although probably only an opinion unsupported by facts, testimony from a descendant of the original possessors of the tract is interesting. Mrs. Louis Hansen says that her mother (an Alleghenian) told her that raccoons catch many trout. Many times while a girl she had been berrying with her mother and had heard the sound of stones being moved in the brook-bed. Her mother said on these occasions that the raccoons were getting at the trout that had taken refuge under the stones. Most of the hunters interviewed doubted whether the number of trout left in pools and thus caught by raccoons had any appreciable effect upon the supply.

It seems very probable that the number of raccoons is being thoughtlessly reduced because of the common practice among hunters and trappers of destroying den sites by chopping down the trees in order to capture the animals. From information received from various sources throughout South Valley it is certain that many hunters, if not most of them, violate the game law in this respect. When the den is located, the tree is felled and the occupants, one or more, are killed. A photograph (Fig. 19) of a tree thus felled was taken in the South Branch of Sawmill Run. Because the raccoon family usually dens up together, the young staying with the parents until a year old, the number taken is often four

or five times the number usually treed by hounds or trapped in the legitimate manner of capture, and a den site for future generations of raccoons is destroyed. This reprehensible practice therefore is one that should be discontinued in the interests of hunters and trappers themselves.

*Gray Squirrel.* This popular game animal was found to be rather scarce throughout the tract, but especially in Division II, where the habitat not only is less suitable but is more exposed to hunting than is the woodland to the south. Several hunters in the area accepted the common belief that this animal is highly migratory, traveling considerable distance in order to reach a good supply of food when the crop of nuts fails in its home locality. Dr. Hawley stated that the winter of 1924 had much deep snow and followed a fall when the acorn crop had practically failed. The squirrels were scarce that season but their abundance the following year forces him to believe that they migrated to a more favorable region rather than starve to death; later coming back with the recurrence of food. On the other hand, Mr. Harold Walters of Sample Hill stated that a large number of squirrels remained after the hunting season that fall, and that the severe weather and food shortage almost wiped them out. In proof of his statement he avers that he found four or five gray squirrels frozen to death, in holes in trees cut for firewood, and tracked another that had wandered far from trees to some farm buildings, evidently in search of food, and finally found that it had suffered the same fate.

Like many other animals, gray squirrels are at times hosts for parasitic worms. Mr. Harry Moore of Pierce Run informed me that fifteen to twenty years ago, about 1905 to 1910, gray squirrels were very abundant. Then followed a period when practically all he shot were infested with white "grubs," some as thick as a man's little finger, evidently a warble which burrowed through the skin of the neck. The squirrels disappeared "almost over night." Mr. Pickup believes that the red squirrel is perhaps the greatest enemy of its larger relative; he has observed them fighting many times, and thinks that the red squirrel gets the better of it. Mr. Saxton, however, believes that man is practically the only enemy, and, in his vicinity at least, not a serious one.

With regard to local breeding habits of the gray squirrel, Mr. Saxton has found several litters of young, one of which contained four and another five, born about the middle of May.

*Flying and Fox Squirrels.* Neither the flying nor the fox squirrel was seen by me in the course of the field work. Most of those

who contributed information on the game and other animal life of the tract told me that at least a few flying squirrels occur, but their relative abundance is difficult to judge because they are seldom seen.

Mr. Pickup thinks that there may well be a few fox squirrels along the Allegheny River, but that there are probably none on the area under investigation. Dr. Hawley, however, states that they are "occasional" on the tract.

*Red Squirrel.* This animal seems to be on the whole relatively scarce in the tract. Only a few were seen or heard or their nests located during the survey. I was told by Mr. Walters that the red squirrels are very scarce in the neighborhood of Sample Hill and by Dr. Hawley that, although very abundant eight or ten years ago, they have steadily decreased in numbers. Mr. Saxton of Onoville declared that red squirrels are still present in fair numbers, although relentlessly shot as a nuisance by many hunters, and that they are quite uniformly distributed over the whole tract. Despite this persecution and contrary to declaration by many hunters, he has noted little fluctuation in numbers. He thinks the hawk is, next to man, the greatest enemy of the red squirrel.

I was told by Mr. Howard Robbins that the red squirrel is abundant in the southwest corner of the tract, but personally I noted no difference as between this and the other sections.

*Chipmunk.* This species was so plentiful that no record of occurrence was kept. It was well distributed in all suitable habitats. Residents believed the period to be one of unusual abundance. If there was any unevenness in the distribution of the chipmunk population, I believe the region about Onoville contained greater numbers than did any other district of like size.

*Woodchuck.* Practically all farmers whom I met denounced the woodchuck as an unmitigated pest. Mrs. Mighells of Bowen stated that many farmers in that vicinity are poisoning it according to instructions given by a County Agent, but that south of the farming district of this section no measures against it appear to have been taken. Woodchuck burrows I found to be quite evenly distributed over the tract, although they are more numerous of course in the neighborhood of cultivated fields (Fig. 20) than in woodland (Fig. 21). They were noticeably more numerous, however, in the section from Pine Hill to Carr Corners and for about two miles northwest of the latter place. A small field of perhaps three acres, on the flat hilltop northeast of the Pine Hill School, was very badly infested and a count revealed 22 burrow entrances in

this field; so that one can perhaps safely say that the field supported five or six family groups of woodchucks.

Following the severe rains of the first part of September a few woodchucks with ill-placed burrows evidently were flooded out. For example, a recently used den in area 63 was filled with water by a rivulet which happened to have its course in that direction.

*Porcupine.* Although common throughout the wooded part of the tract and destructive about unoccupied houses (see Fig. 22), the porcupine is not numerous enough to be injurious to forest growth. The most common sign of the presence of porcupines in a hardwood forest is usually the blaze-like scars, at various heights, depending upon the snow-level, on the beeches, but only one instance of this sort, a nearly complete girdling of a large beech, was seen in area 37. Only two living individuals were seen, one in area 41, on September 7, and the second on September 10, in area 61 (see Fig. 23); but the remains of two others were found in a shed on the abandoned farm on the ridge-top between Phillips Brook and Pierce Run. Dr. Hawley stated that porcupines are quite numerous in the wooded areas south of Randolph village, and Mr. Howard Robbins said that the same is true for the southwest corner of the tract.

*Muskrats.* Although more plentiful than, for example, the mink, the muskrat cannot be called a common animal of the tract. In Division I, it inhabits the lower parts of the Runs and seems to prefer the cultivated to the wild sections. This was evidenced especially in Bone Run, the lower part of which flows through pastures and hay fields, and in the swamps on both sides of the Pine Hill-Randolph road, about a half-mile north of road-junction "20-35." These swamps are close to the highway and more or less surrounded by open grassland or pasture. Muskrats seem, on the whole, to be scarce in Division I, considering the large amount of available habitat. In the northern part of the tract the two neighboring localities north of Pine Hill (mentioned above) are well stocked; and tracks, partly eaten food and feeding mounds were especially plentiful in the area to the west of the road. The respective owners of these two areas, Mr. Pickup of Randolph and Mr. Price of Faulkner, are developing their properties for the purpose of fur-farming. Mr. Price estimated that he had twenty muskrats per acre on the best three or four acres of his swamps, and he stated that he has seen as many as six muskrats swimming together in the pool shown in the foreground of figure 24. This is, however, an exceptionally good habitat, and is protected from encroachment of trappers who





Fig. 21. Woodchuck burrow in the North Branch of Bone Run.



Fig. 22. Porcupine work in an abandoned house in Bone Run.



Fig. 23. Porcupine in defense attitude; back towards the camera.



Fig. 24. Muskrat habitat in a partly artificial swamp north of Pine Hill. Partly consumed food, feeding platforms and remains of abandoned houses were in evidence.



are, in the opinion of Mr. Saxton of Onoville, responsible for what he terms the scarcity of muskrats in the vicinity of that village. He estimates that despite the efforts of many persons, only 15 or 20 were caught in his locality last winter. There is, however, plenty of food. Protection for a period of years, with a reduction in the number of weasels would, in the writer's opinion, bring back these very interesting and valuable animals to a point where they would be safely established and a source of considerable revenue to the local residents.

The small amount of water necessary for the existence of these animals was evidenced several times. On July 8 a burrow was found in the sandy bank of Bone Run, about 100 yards east of the school. On this date the Run was here very low and at points below dry for considerable distances: according to testimony, a normal condition in summer. The den in question was located above the only sizable pool in some distance, the water being about two feet deep at most. Figure 25 shows the Run at a much later date (September 12) after many heavy rains had raised all the brooks to unusual heights. Another muskrat locality was found on Battle Creek between area 283 and the road a short distance to the east. Figure 26 shows the conditions: marshy ground covered with hummocks and rank grass and willows, with the creek an inconspicuous and scarcely moving thread of water almost hidden in the grass. Two burrows and runways were discovered, and I was told by Mr. Harold Walters of Sample Hill that two or three muskrats usually live in this locality.

I am indebted to Mr. E. Stanley Mighells for the only evidence of disease. A muskrat was found a few feet from Bowen Corners, lying on the edge of the gutter which contained only water from the drainings of the icebox of the near-by store. The animal was nearly dead when found; it was in good condition of flesh and showed no outward signs of injury except that a larva of the genus *Cuterebra* protruded from the skin of the neck.

*Snowshoe Rabbit.* One of the best game animals of the tract is the snowshoe rabbit. Judging from testimony of residents and from personal observations of signs it appears to be only fairly common in the slashings and on the ridge-tops of the more densely wooded part of the tract. It is scarce in the agricultural section. The species is found most frequently in Phillips Brook, Pierce Run, Hotchkiss Hollow and Jones Hill, according to statements of three local informants, and my own observations confirmed this testimony, especially for the first two valleys named. Mr. Fred Seitz

believes that the most favorable localities around Onoville are (1) North of Onoville, from the village west to a point north of the school, and along the ridge-top south of Sawmill Run; (2) between the Allegheny River and Browns Run as far west as State Line Run; (3) between Browns Run and the South Branch of Sawmill Run.

Mr. Seitz and Messrs. Harry and Paul Moore, contrary to the opinions of several other hunters, believe the snowshoe rabbits are numerous, having increased during the past four years, and that the protection from hunting accorded the species during 1926-27 was not needed, at least in this tract and the adjacent territory. It would seem, therefore, judging from extensive local testimony, all of which was gathered before the protective measure was passed and therefore is free from prejudice in that regard, that hunting has not here seriously affected the numbers of the snowshoe rabbits.

Harry Moore, as well as some others, thinks that snowshoe rabbits remain, on the whole, about the same as to numbers, and explains the apparent great fluctuation by their habit of migrating; but as to the cause of this migration, he had no theory to offer. He has noticed that one year a certain section will be densely populated, the next year it will be deserted, while another locality several miles away will be well populated. As an illustration he mentioned that rabbits were very scarce in Pierce Run valley two years ago, but now they are common.

Mr. Pickup was apparently the only person who had noticed any signs of disease. He had occasionally found rabbits afflicted with some skin trouble, which he described as being much like mange of domesticated animals.

With regard to the breeding season in this section, according to Mr. Pickup, the young are born during the first two weeks of May. And as to food habits, all the hunters interviewed were unanimous in stating that both cottontail and snowshoe rabbits here eat the same varieties of food.

Regarding natural enemies, Mr. Schrader believes that the weasel is by far the greatest enemy of the snowshoe rabbit. He declared that he had several times within the past few years found carcasses of this species, which had been killed by the weasel. Mr. Pickup lists the weasel and the red fox as the two chief enemies, while Mr. Saxton believes that only a few rabbits are taken by foxes or owls. Mr. Paul Moore declares that he has found many cottontails killed by weasels, but *never* a snowshoe rabbit. Such contradictory testimony is encountered frequently and illustrates well the



conflict of opinion met with among hunters, even in the same locality.

*Cottontail Rabbit.* This was found to be abundant throughout the tract. It was particularly noticeable along the road in the Phillips Brook valley, especially in areas 190 and 194, and on the road in the North Branch of Bone Run valley, from Bone Run northward for about three miles. All persons questioned agreed upon the unusual numbers occurring and this testimony had reference practically to the entire tract. Every suitable patch of young growth, especially along the roads, seemed to have its cottontail occupants.

According to some local residents in the territory, these rabbits are subject to the disease Tularemia, but authentic evidence of this is lacking. Harold Walters, of Sample Hill, said he had noted that the rabbits overtaken and killed by his dog were badly afflicted with this disease, while those that were able to outrun the dog and then shot did not seem to be afflicted, or only slightly. Dr. Hawley says that eight years ago the rabbits were badly diseased, but that the epidemic appears now to be almost over. Although Tularemia has been known to affect rabbits in many sections of the United States, biologists have, so far as known, up to the present time found no positive evidence of its occurrence in the northeastern states including New York. It seems hardly probable that this disease could have existed here without its identity becoming definitely established, especially since human beings are very susceptible to it.

During the fall of 1909, Mr. and Mrs. Robert Beatty of Onoville noticed that the cottontails were afflicted with a serious attack of "maggots," which burrowed in the flesh of the neck but remained attached to the skin in such a manner that when the pelt was removed they came away with it, leaving empty pockets in the flesh which were more or less filled with pus. These were present also, more or less, under the chin.

Most of the persons with whom the matter was discussed had noticed fluctuations in the numbers of the cottontail and agreed that it is now in a period of increase on the tract. Dr. Hawley believes that disease is responsible for the fluctuations. While many rabbits were shot during the past season (1925-26), this seemed not to reduce the numbers appreciably. Judging from the present abundance, conditions should be about right now for a recurrence of an epizootic, and a consequent reduction of the rabbit numbers.

According to Mr. Schrader's observations, cottontails breed about March 1; the gestation period is six weeks and the young, averaging 8 to 10 in number, are born between April 15 to May 1. Mr. Hansen

and Mr. Saxton believe that cottontails have only 4 or 5 young to a litter. Mr. Saxton, however, thinks that these rabbits breed in April and that they have 2 or 3 litters yearly. Dr. Hawley believes that the young are born about April first, the litter containing 5 or 6.

Mr. Schrader says that both cottontail and snowshoe rabbits are very injurious to young growth, often producing "catfaces" which harbor decay, and, while not killing the tree, have the same general effect as the similar injury caused by fire.

According to Mr. Hansen, rabbits (both species) eat the bark of sumac, apple, and black, white and gray birches, often causing injury of this sort sufficient to kill small trees.

Dr. Hawley believes that these animals ordinarily eat grass and clover, but eat bark when forced to do so in winter. He has noticed that they prefer apple trees and rose bushes, but he thinks that their effect on forest reproduction is slight.

The author found an interesting case of selection of food by rabbits in the northern part of area 276, about a half mile southeast of the Bowen Corners. The edge of a sugar orchard containing approximately equal amounts of beech and hard maple reproduction showed that many beech had been more or less stripped of bark, while apparently not a maple had been touched.

Mr. Louis Hansen and Mr. Saxton believe that the weasel is the worst enemy of rabbits. The former has observed that it burrows through light snow to its prey, sometimes traveling considerable distances without coming to the surface. Second he places the mink, which, however, is scarce. He has also found rabbit burrows containing partly eaten bodies of the occupants, destroyed by skunks. Hawks he places fourth, but says that they are scarce in his locality (on the Reservation) this year. Some light may be shed on destruction of game by the crow from Mr. Hansen's statement that several years ago he and his wife watched a single crow carry off five small rabbits (probably cottontail) from the edge of the clearing in which his house is located, into the woods on the opposite side of the field. It made five trips, each time passing directly over the house and sufficiently low so that both were sure of the identification of the prey, which squealed frantically.

Mr. Paul Moore of Pierce Run states that the weasel is very numerous in the region about the lower part of the Run; and has found many cottontails killed by it. He has noted the bloodthirsty habit of this small carnivore, having several times followed its trail where it had continued killing rabbits apparently after its appetite had been satisfied.

The enemies of the rabbit, states Dr. Hawley, are the fox, the weasel, the owls, and the goshawk.

*Deer.* The Cattaraugus tract lies within the area which, according to Seton '09 (*Life-Histories of Northern Animals*, Vol. I, pp. 674-1267), was once a part of the range of the white-tailed deer. Due to protection and also to the restocking of the adjacent Allegany State Park, the species is now coming back and individuals are occasionally seen in the wooded sections of the tract. I was told by Mrs. Maynard Price that she had seen a deer on Pine Hill, in June, 1926. Two choppers employed at the Ostrander sawmill in Hotchkiss Hollow said that they saw tracks several times during the month of July, in the large draw on the north side of the Hollow. Harry Moore of Pierce Run states that several deer yarded during the winter of 1925-26 in the northwest corner of the opening on top of Braley Hill, just west of the road designated by that name. During the summer of 1926 he also saw the tracks of five deer between Mud Creek and Bone Run and west of the North Branch of Bone Run. Mr. Wilford Dence, of the Roosevelt Station staff, saw the tracks of a deer along the brook which flows east into the North Branch of Bone Run. Mr. Richard Johnson, living at the head of this brook, said that two deer were then coming regularly to the vicinity of his barn and he believes that there is at least a third one in the neighborhood.

Deer are also not uncommon in the vicinity of Onoville. On July 10 one crossed the road south of the corner store owned by Mr. Fred Seitz, who again saw one in the same place about August 15th. He informed me that three deer spent the winter of 1925-26 on the northeast corner of the hill north of Onoville, in the eastern part of the area designated as 104. During July three deer made frequent visits to a potato field on the farm of Charles Anderson, on the hill north of the schoolhouse, in the North Branch of Sawmill Run. They did no damage except to nibble a few potato tops.

Besides the animals just mentioned as of occasional occurrence in the tract, one or two others may be mentioned purely on the strength of local reports. Mountain lions or "panthers," for example, are reported from time to time, but Mr. Paul Moore, among others, has never seen any actual evidence of their presence and believes that they are merely the product of the imaginations of nervous people.

The opossum, it was said, has been known to occur in this locality, and years ago one was captured within the boundaries of the tract concerned in the present survey. Several others were reported to have been taken on the Indian Reservation.

Among introduced species the common or Norway rat sometimes resorts to open fields, and the den of such an individual, shown in figure 27, was found on the bank of Sawmill Run above Onoville.

**Game Birds.** *The Ruffed Grouse.* This is the most important game bird of the tract and seems to be fairly common. It is, of course, found more frequently in Division I than in the more open agricultural land of Division II, even in areas of the same size and desirability as grouse habitats. This is partly because of the pastured conditions of much of the woodland in Bowen and Vollentine, and partly because of hunting, which undoubtedly is more intensive in the northern part of the tract than farther south. But the observations of a single season are hardly sufficient for a safe estimate of the grouse situation. Certain individuals, however, who have been much afield in the tract during many years expressed definite though somewhat varied opinions.

For example, Mr. Louis Hansen and Mr. Fred Saxton of Onoville believed that grouse are about one-fourth as plentiful at present as they were twenty years ago; while Mr. David Tucker, also of Onoville, believed that they are about half as numerous as they were twenty years ago, but added that the grouse population declined tremendously in the twenty years preceding this period, estimating that there are now only about 2 per cent of the numbers found in 1886. Mr. J. F. Schrader of Bone Run has also noted a considerable decrease. Dr. M. C. Hawley, who is a resident of Randolph but who has done considerable hunting in the tract, concurs in the statements of scarcity, saying that there are not over 50 per cent of the number of grouse of twenty years ago. On the contrary, both Mr. Harry Moore of Pierce Run and Mr. Leone Pickup of Randolph are of the opinion that the birds are just as abundant now as they were at that time, Mr. Pickup going so far as to state that if any change has occurred it has been in the direction of an increase in the past ten years. Mr. Howard Robbins, living in the southwest corner of the tract, says that ruffed grouse are now fairly numerous in his locality. Both Mr. Saxton and Mr. Moore declared that grouse were more plentiful a few years ago than they are at present. As to fluctuation in grouse numbers, all the persons interviewed believed this was due to cold, wet spring weather which is disastrous to the chicks, and to forest fires at that season. Deep, light snow is also bad, according to Mr. Moore, as the birds have the habit of burying themselves in it, when many fall prey to foxes. No one had noted any signs of disease.



Most of the hunters agreed that the common use of dogs had greatly increased the number of grouse killed during the past two or three open seasons, but some men, including Mr. Tucker, Mr. Saxton and Mr. Pickup, think that this has had little effect. In the vicinity of Onoville relatively little hunting has been done for the past few seasons and while Mr. Hansen and Mr. Tucker believe the grouse even here are decreasing, Mr. Saxton is sure that they are increasing. In that part of the tract which lies in the town of Randolph, hunters, especially from Chautauqua County, are very numerous during the open season, yet despite this fact Dr. Hawley thinks that the ruffed grouse is increasing in numbers. He was unable to give an estimate of the number shot.

Map 6 gives an idea of the general distribution of the ruffed grouse in the tract, but a word on its relative abundance is necessary. While my own observations are recorded on Map 3, the experience of those who hunt the grouse in the tract adds some detailed information, and their expressed opinions are worthy of consideration. Mr. Fred Saxton says the birds are plentiful on the Indian Reservation, where they are hunted less than on areas outside, and in area 104 on the south slope of Bone Run, where food is plentiful. A typical view in this place is shown in figure 14. Mr. Schrader has observed, he said, that grouse may always be found in winter in hemlocks, while in spring and through the nesting season they are usually on the dry ridges (see Fig. 15). Mr. Harold Walters of Sample Hill usually counts on the presence of a covey in each patch of woodland in his neighborhood. Mr. Paul Hitchcock, who lives on the Pine Hill-Randolph road, about  $1\frac{1}{2}$  miles north of Mr. Walters, says that there are always "a few" grouse in the woods and partly grown-over pastures of area 276. Mr. Leone Pickup believes that Pierce Run has more birds per square mile than any other part of the tract. From this as a center they have stocked Phillips Brook and the south slope of Hotchkiss Hollow. Two choppers on the north slope of the latter stated that they had seen no grouse in the course of their work there, and, while this type of work is not of a nature to favor observation, the testimony probably indicates that the birds are not plentiful, and my own experience would confirm this view. Mr. Harry Moore states that there are many birds in the young growth on the north slope of Pierce Run above the school. He believes that food, more than any other one factor, determines the distribution. I was informed by a resident of the tract living on the lower road northeast from Ivory, that in his vicinity grouse are "not plentiful." Dr. Hawley believes Pierce Run to be the most favorable locality, while

Mr. Daniel Murphy on Sawmill Run informed me that grouse are also plentiful in the dense growth of area 66.

In regard to the natural as well as the human enemies of the grouse and to the winter conditions in the tract, the testimony of resident hunters is also of importance.

Grouse enemies are very plentiful in the tract, according to Mr. J. F. Schrader. He says that there are many hawks and weasels and a fair number of foxes. But it is true, also, that the many sportsmen who now come from surrounding cities, are able, because of the automobile, to cover a much larger territory than formerly was possible, and can hunt districts which before were more or less immune due to difficulty of access. The widespread use of dogs in hunting, it is believed, has also greatly contributed to the decrease of grouse population. According to Mr. Schrader, there are many domestic cats roaming through the woods, and they are believed to account for the destruction of many young grouse.

Mr. Hansen believes that natural enemies are not so important a factor now as formerly. The wildcat (*Lynx ruffus*) was once a common enemy, but has been practically exterminated. Mink and foxes were also important, but are now scarce. Weasels are common, but Mr. Hansen believes that the importance of this enemy has been overestimated, although it may occasionally catch grouse. But cold winters and cold wet springs are thought to have been very detrimental. Forest fires, all of them man-caused and preventable, have doubtless destroyed large numbers of birds in the past, especially in late spring. He agrees with Mr. Schrader that the use of dogs and of automobiles, together with better guns, has been chiefly responsible for the reduction of grouse numbers.

Other resident hunters expressed varying opinions as to the cause or causes of the diminishing number of grouse, some holding the fox and the weasel chiefly responsible, among natural enemies, and the great horned owl next in order, but the various hawks and the crow relatively unimportant. Mr. Leone Pickup estimated that there were five foxes per square mile in this territory, and three owls, presumably the great horned. He had never seen any evidence that the crow was destructive to the grouse. Restricting hunting alone, he believed, would be sufficient to bring about an increase of the grouse; food and shelter were already sufficient to support a large number, and constituted no problem.



Fig. 25. Entrance to muskrat dens in Bone Run, near the Bone Run School.



Fig. 26. Muskrat habitat on Battle Creek, near Bowen. Two burrows and several runways are concealed in the grass near the willows in the middle foreground.





Fig. 27. Den of a common (Norway) rat in a mound on the bank of Sawmill Run.



Fig. 28. The forest floor habitat; home of the ruffed grouse, oven-bird, junco, etc.



Several hunters believed that sportsmen's dogs destroy many young grouse before the season opens—the dogs being in the woods while their owners are hunting other game, such as gray squirrels, on which the season opens early.

Practically every one of the persons interviewed considered that winter conditions in the tract are not too severe and that the grouse generally come through this season in good shape. Cover is good and is yearly becoming better, while food is abundant. Consequently Mr. Harry Moore stated it as his opinion that three times the present number of grouse could winter on the amount of food now growing in the tract, which would seem a very moderate estimate.

My late arrival in the tract precluded the finding of any nests with eggs, but records of broods of young met with were kept and are here presented in tabu'ar form.

(TABLE I.—SHOWING SIZE OF GROUSE BROODS ACCORDING TO PERSONAL OBSERVATIONS)

LOCALITY	Num- ber in Brood	Date
State Line Run.....	5	July 28
North of Onoville.....	6	July 3
Near Bone Run School.....	11	July 7
West side Phillips Brook.....	6	July 12
Mud Creek Bottom.....	10	July 14
South side Pierce Run.....	1	July 20
Upper Pierce Run.....	4	July 21
Steamburg-Carr Corners Road.....	3	July 23
South slope Hotchkiss Hollow.....	9	July 23
Near Pierce Run School.....	2	July 29
East of Ivory.....	6	August 19
North slope North Br. Sawmill Run.....	4	August 30

Inquiries made of local grouse hunters in regard to the number of eggs in a clutch and the number of young in a brood, brought various replies and opinions, but little exact information. J. F. Schrader declared that he counted the shell remains of as many as 18 eggs in one nest. Fred Saxton considers the average brood to number from 8 to 15, while Leone Pickup would place the number between 12 and 18, and Dr. Hawley, between 8 and 10; Harry Moore gave it as 5 to 9. The largest brood actually counted by Dr. Hawley, consisted of 15 chicks.

*Woodcock.* My own experience with this bird on the tract was limited to a single bird seen in area 200 in Pierce Run, on July 22,

and the observation of the familiar "drillings" of the bird in Mud Creek, about August 25. That woodcock exist here is therefore undoubted, but they must be considered rather scarce. This was further confirmed by Mr. Fred Saxton who stated that woodcock are present only along the Allegheny River, where they find the moist, swale woods they require. He believes that no appreciable number are to be found in the Runs outside the Reservation during the summer.

Howard Robbins said that a small number occur in both South Branch of Sawmill Run and State Line Run, near the county line.

Dr. Hawley also said that this bird is scarce in the tract, and would place its numbers at only 10 per cent of those present 25 years ago.

According to Mr. Schrader, the woodcock has increased somewhat in the past few years because more swampy land has been cleared of timber, creating swale conditions. He thinks that the past two hunting seasons have not decreased their numbers noticeably. He has noted no fluctuations.

The natural enemies of the woodcock in the tract are probably the usual species of flesh-eating birds and mammals, but Mr. Schrader considers the stray domestic cat the most destructive.

*Pheasant.* This introduced game bird appeared to be rather scarce in the tract. The northern section or Division II is the only part of the tract at present suitable to this species, the habitat of which is the grainfield and brushy fence corner rather than the woodlots. A favorable locality for this bird is represented in figure 17. The pheasant was said to be common along Conewango Creek, and occasionally to reach the upland of Bowen and Vollenhine, but the lone individual which I actually saw was on the Reservation, near the mouth of State Line Run.

Ever since its introduction into the country, this exotic bird has been the subject of much debate concerning its suitability as a game bird. It will be brought out later that it does not, in southern Cattaraugus County, come through the winter season in satisfactory condition, although I do not believe that its unfitness has been demonstrated. While I personally do not consider the pheasant as worthy a game bird as the ruffed grouse, it is, nevertheless, a bird of the open where the grouse is not at home, and therefore, if one were to stock as fully as possible such a composite tract as the one under discussion, there is much to be said for it as a good game bird for the agricultural section. For this purpose the pheasant seems at present to be the best choice, although the question of

bringing back the bob-white is, in my opinion, yet to be settled. There may be some question as to the feasibility of feeding this game bird through periods of severe cold in winter, practically a necessity demanded by the conditions.

With regard to general conditions of health among the pheasant population of the tract, especially in the district of Conewango Creek where they are most common, everything seemed favorable, according to local residents. There is the opinion of some, as for example, Mr. Pickup, that the hens are less resistant to adverse weather conditions than are the males, and that therefore the cocks outnumber the hens in the district. The most unfavorable season he had noted since the introduction of the pheasant was the spring of 1926, when there was much rain and snow. According to Dr. Hawley, many of these birds die during severe winter weather. At such periods it is customary to feed them, in the vicinity of Randolph, and Dr. Hawley believes that if they were not fed a severe winter would exterminate them.

Mr. Leone Pickup estimates that there are in the hills about one-tenth of the number of birds found in an acre of Conewango Swamp.

With regard to local distribution, Howard Robbins informed me that he had never seen pheasants in his vicinity—that of the junction of the Browns Run road and the county line; but about one and one-half miles north of this place, along the Pine Hill-Randolph road, the birds are seen occasionally, according to Paul Hitchcock. As before remarked, pheasants are considered common in the valley of the Conewango, and according to Dr. Hawley, they extend back into the hills on each side of the creek for six or eight miles. On the adjoining Indian Reservation they are said to be practically wholly absent, due to unrestricted hunting.

Along the Erie Railroad they are said frequently to be attracted by grain dropped from the cars. Mr. Jason Stone, who lives about one fourth of a mile northwest of the Corbett Hill School, had seen about a dozen pheasants in his wheat field, on August 6.

In the neighborhood of Sample Hill, pheasants are more scarce, according to Harold Walters, than they were several years ago. He thinks that those then present either left the vicinity or were poisoned by prepared corn intended for crows.

Mr. Fred Saxton states that pheasants are very scarce in the vicinity of Onoville.

Mr. Godfrey Bern, the owner of a farm on the county line between the North Branch Sawmill Run and Bone Run, informed me

that the birds had not been in evidence this year, although he had seen two last year (1925).

The broods of young hatched in the tract appear to be of healthy size. The covey mentioned by Mr. Jason Stone contained one adult with 12 young; and Dr. Hawley estimated that the broods average about such a number.

With regard to injurious habits of the pheasant, according to Mr. Pickup the farmers in the vicinity of Randolph complain that it does considerable damage to their crops. Dr. Hawley disagrees on this point, but admits that had not the open season been made longer than usual during the fall of 1926, the farmer would probably have become an enemy instead of an ally of the sportsmen of this section.

Winter conditions, due to cold and deep snow, are, as already suggested, very severe for pheasants, according to all my informers. The birds have plenty of cover, but must be fed by man. They obtain a good deal of subsistence, however, from rotten apples, eating both the pulp and the seeds; and orchards, both tended and abandoned, are very common throughout the open areas of the tract. Feeding by sportsmen and birdlovers during the winter time prevents much greater loss. But there is no organized effort of this sort; it is all voluntary and, while far better than no action at all, is of course not so well directed and effective as it would be if properly organized.

The present method of voluntary feeding by residents of a locality, I was told, consists often of merely filling a pocket with poultry food when bound for the fields. This feeding is of course very irregular and wholly insufficient both in the amount of food distributed and in the number of localities covered. On a tract such as the one in question a warden might be designated for making the rounds of a number of feeding stations, which should be so located as to serve the greatest possible number of birds. Restocking with live birds is both expensive and unsatisfactory; and few American sportsmen have a taste for anything approaching the "Old Country" methods of stocking a locality with game immediately before a hunt, for the sole purpose of bringing it home in the bag. It is more desirable and less expensive to save the birds already here than to replace a depleted breeding stock with imported birds.

But regarding the problem of increasing the numbers of the pheasant in this area, local opinion appears somewhat doubtful. Mr. Pickup believes that the species is confronted with certain limitations. The present habitats are even now, he thinks, populated to



capacity in fall and winter, but because of adverse winter conditions, are underpopulated when spring arrives. Weather he considers the chief factor. The hunting season on the bird as going into effect in the fall (of 1926) is apparently satisfactory, so far as its probable effect on the pheasant is concerned. Organized winter feeding would doubtless do more toward increasing its numbers than any other single act.

**Bird Life in General.** Besides the birds especially of interest to the sportsman, there is also the host of small birds which are attractive to most people interested in nature. These chiefly insectivorous birds are of the greatest importance economically for they help protect the crops of the farmer against the hordes of insects ever ready to increase beyond bounds once the natural checks, one of the greatest of which is birds, are removed. This phase of bird usefulness has been too often and too well elaborated to need repetition here, but is cited to bring to mind again the great importance of our small birds and the necessity for including them in a report on wild life. An attempt will be made to give a sketch of conditions as they affect bird life and of the life itself as found in the tract during the course of the survey.

With the exception of marshes, the tract is rich in suitable bird environments. There is wild land as well as settled farming country and this in itself bespeaks a variety of environments suitable for different species of birds. Some, such as swallows, sparrows, the robin, etc., frequent the vicinity of buildings and open fields and such habitats are numerous and fairly well distributed in the area. Then, again, there are solid tracts of woodland which are more congenial to certain other species. These settled and unsettled areas together with the many small streams make ideal surroundings for a great variety of bird life, excluding, however, such as are strictly marsh forms. Only two marshes, each of about five acres, exist within the tract and these are situated about three miles south of Rando!ph village, on the Pine Hill road. A part of one is shown in figure 30. The forested sections vary from areas several miles in diameter, without any break other than more or less unused logging roads, to small patches an acre or less in extent. Here are unlimited resources for the woodland species of birds. The cultivated and open character of other sections provides ample food and congenial habitat for the many birds of the open, and the run-down or abandoned farms, especially in the southern half of the tract, create ideal conditions for many species favoring thickets, thicket margins, and other waste areas.

An abundance and variety of bird habitat generally means an abundance and variety of bird life, and this holds true for the tract in Cattaraugus County. It is rich in its number of species as well as individuals of the insectivorous and seed-eating birds, and is well represented in the birds of prey. For both the amateur and the professional bird student the tract therefore offers excellent opportunities.

In addition to the above qualifications, an area to be suitable for bird study, especially for amateurs, should be readily accessible. To the professional also the question is important, but he is prepared to put up with more and greater discomforts in order to gain his end, and furthermore usually makes a more prolonged stay in a locality. The amateur, as the word implies, usually has some other profession, and often has but little time to devote to what is his or her hobby; that time is precious. The amateur bird student, like the amateur nature student generally, is furthermore an individual whose kind is increasing and should be encouraged. It is the interest and the influence of the amateur that is helping the cause of the sportsman in establishing and maintaining natural areas where game as well as other wild life may be conserved and increased. Through him also will come about a helpful diffusion of knowledge concerning the value of our common birds, and the arousing of more general interest in birds through actual first-hand study. An area such as the one in question should therefore be easily accessible to as many people as possible; but at the same time the preservation of conditions under which birds thrive suggests that the centers of population should be at some distance.

Roads within the tract itself are all non-surfaced and only in the northern part are they suitable for constant automobile traffic. The roads through the Runs in the township of South Valley are excellent when the sparse population is considered, but, except for the Onoville-Jamestown "Hill" road, they will not stand heavy or fast traffic. In many respects this is advantageous in helping to preserve bird habitats and in forcing less serious persons to adopt a mode of locomotion more in harmony with the surroundings. As may be learned by study of the map of the tract, any part is accessible within an hour's walk from passable automobile roads. Many logging roads are available for hiking, which offers the best if not the only method of observing birds successfully.

Living accommodations, for such as might wish to stay on the area for prolonged study, are very limited. Except for a small hotel in Onoville village, there is no house catering to the wants of the trav-

eling public within the limits of the tract. However, for those desiring to live in one of the towns or cities in the vicinity, Salamanca, Randolph and Jamestown are suitable bases of operation, all being within ten miles of the tract.

An area to be ideal for bird study should, perhaps, offer the student all types of birds. It has been mentioned previously that marsh habitats, and therefore most marsh-loving birds, are almost wanting. Marshes furthermore are the homes of various mammals, such as muskrats, mink, weasels and other fur-bearers, which use them as places of refuge against man and find in them their essential requirements of life. Swamps or marshes have, generally speaking, a greater variety of animal life than has any other single type of habitat, and they furnish excellent resting and feeding places for many birds, both game and non-game, in their seasonal migrations. It is well, therefore, for a wild life tract to include such so-called waste places. But while lacking within the present tract proper, a few miles to the east lies the Conewango Swamp, several hundred acres in extent, which borders the creek in its meandering course east of Randolph. This swamp is not indicated on the map, but in it herons, rails, coots, snipes, marsh wrens and other typical marsh birds are known to be common in the proper seasons and provide good opportunities for study. There has been little encroachment upon its area in recent years, but an important habitat such as this should be preserved intact and placed beyond the reach of possible drainage schemes.

With respect to bird enemies, it may be said that they are common, but no more so than in other similar areas. Hawks collectively are common, although it is recognized that, of those living on the tract, only the sharp-shinned and Cooper's hawks are likely to destroy any appreciable number of birds. The sharp-shinned is not common, and is even rare in the wooded part of the tract south of Vollandine. The Cooper's hawk is also rare in this section, but is almost as common as the larger but less harmful red-tailed and red-shouldered hawks in the open country immediately south of Randolph. Owls are of course less commonly seen than the hawks, but the great horned owl undoubtedly is present in usual numbers and probably does more or less harm among the non-game as well as the game birds.

Among the mammals, mink are considered uncommon and their depredations are therefore probably negligible. Weasels, however, are common, but their actual influence on bird life is as yet not certainly known. The red squirrel is apparently not plentiful at present and it probably does little harm. Skunks are common and may affect

ground nesting birds to some extent, but their known habits as grub and insect eaters make them a very important economic asset in farming districts.

For the control of bird enemies reference is made to Saunders' Birds of Allegany Park (Roosevelt Wild Life Bulletin, Vol. I, No. 3), as well as to a general policy suggested for the tract under consideration and presented on another page.

*Abundance of Birds.* In a report covering the principal forms of wild life of a tract of the size of the one under discussion, it is in general outside the limits to present any detailed statement as to the relative abundance of each of the many species. It will, therefore, be convenient here, except in a few cases, to consider the status of the birds by larger categories.

Hérons and bitterns are relatively scarce in the wooded parts of the tract, although several green herons occur along each creek or run. In the northern part, however, due probably to the proximity of the Conewango Swamp and to the several marshes and ponds in Bowen and vicinity, these large birds are common.

The spotted sandpiper and the killdeer were found to be rather common in the runs of Division I, but were scarce in the open country to the north. A flock of five semi-palmated plovers was seen north of the Bowen Corners. Mr. Mearl Wheeler states that the Wilson snipe is also to be found, although it is scarce.

The grouse was found to be fairly common in the southern division of the tract (Division I), but scarce in the more open country to the north. A few pheasants wander from the Allegheny River valley into the runs where they keep to the small alluvial meadows along the streams. A small number were reported from the southwestern part of the tract along the Cattaraugus—Chautauqua county line, from the Pennsylvania line north to the ridge-top dividing Bone Run and North Branch Sawmill Run. A few more wander from the open valleys to the north and west of the area, up to the vicinity of Corbett Hill, Bowen, and Elkins Brook, but in general the pheasant is scarce within the boundaries of the tract. No signs of bob-white were discovered by me, but Mrs. Iva Mighells of Bowen said she has heard one or two near her home in past years.

The mourning dove is not common, although residents claim that years ago it was numerous, and that it now seems to be recovering from a period of scarcity. The rather unusual sight, at this season, of a flock of seven doves I witnessed in Pierce Run about the middle of July.



The order *Raptores* is well represented, especially by the large hawks of the *Buteo* group. The red-tailed and red-shouldered hawks are quite evenly balanced in numbers and are common in Bone and Pierce Runs and on the north slope of Pine Hill. The marsh hawk and the smaller hawks of the *Accipiter* and *Falco* groups are relatively more numerous in the northern part of the tract, where they may be termed common. The owls are fairly common, the screech owl standing perhaps first in point of numbers.

Both the black-billed and yellow-billed cuckoos are common in the wooded parts of the tract. The belted kingfisher is often seen along the Allegheny River, but penetrates into the Runs and is occasionally found near Vollandine and Bowen. An individual was seen in the valley west of the North Branch of Bone Run, about a mile from the Run.

Of the *Picidae*, the flicker is very abundant and the hairy and downy woodpeckers are fairly common. The sapsucker, and the northern pileated and the red-headed woodpeckers, which have been observed in the State Park, were not seen at all in the tract, although a boring that was evidently the work of the pileated woodpecker was noted in the district between Mud Creek and Bone Run.

Nighthawks and whip-poor-wills are not common, especially the latter the scarcity of which during the past several years was remarked upon by several residents in the neighborhood of the Allegheny River, where it would seem that these birds should be rather common. A fair number of nighthawks were found in the open country in the north of the tract.

Chimney swifts are common. They were most often seen in the lower courses of the runs and over the Reservation than elsewhere.

Hummingbirds were decidedly scarce during the past season, although, from testimony of residents of the tract, this would seem to be unusual. The favorite flower of this bird (bee balm) was abundant.

Flycatchers may be termed common to abundant in the tract. Kingbirds and least flycatchers are very much in evidence, and the wood pewee and phoebe may be classed as common.

Of the family *Corvidae*, the blue jay is common, and the crow abundant, especially in the neighborhood of Pine Hill, which seems to be a gathering place for these birds, and where a flock of 30 to 40 was surprised in an oat field. But it is also abundant throughout the remainder of the tract.

Starlings are present, but nowhere common. They seem to prefer the Reservation and the neighborhood of the runs.

Of the family *Icteridae*, the bobolink, cowbird and baltimore oriole were seldom met with, especially the first, which was noted only in Sawmill Run and in Hotchkiss Hollow. The bronzed grackle was not common in the tract proper, although large flocks were seen along the Allegheny River. On the other hand, the meadowlark and the red-winged blackbird were abundant. At the end of the nesting season, standing grain in some instances was being invaded by red-wings to such an extent that damage was threatened. Mr. Paul Moore of Pierce Run had not seen them so numerous in years.

The sparrow family has a generous representation, some species being abundant. Aside from the purple finch, which apparently was rare (only one bird being seen), and the rose-breasted grosbeak, which was only fairly common, other members of the *Fringillidae* were there in numbers. The goldfinch was abundant, and in the wooded areas one was never far from an inquisitive towhee with his characteristic call-note. I would list the true sparrows in the following numerical order beginning with the most abundant: vesper sparrow, song sparrow, slate-colored junco, field sparrow, English sparrow, savannah sparrow, and chipping sparrow.

The scarlet tanager is common in the wooded sections of the tract.

Barn and cliff swallows were abundant, more so in the lower runs than in the open territory of Vollentine and Bowen. The only bank and rough-winged swallows actually seen were close to the Reservation and even here they seemed scarce.

Cedar waxwings were common throughout the tract, but according to reports appeared to be less plentiful than in previous seasons.

The vireos were represented by three species in the woodlands—the red-eyed, which was most common, the warbling, and the yellow-throated. The blue-headed vireo was not seen here, but probably exists.

The warbler family is represented by at least sixteen species. These beautiful and exceedingly useful little birds are, in general, numerous and are well distributed throughout the wooded sections. The northern parula, pine, Nashville and Blackburnian warblers appeared to be rare, only one individual of each species being seen, while the yellow, black-throated blue, chestnut-sided, and Canada warblers, as well as the Maryland yellow-throat and the oven-bird,

were abundant. The numbers of the last two named were particularly noticeable.

Of the *Mimidae*, the catbird was the only species found on the tract, and it was very common. A lone brown thrasher was noted on the Reservation at the mouth of Bone Run, but I was told that it has been common in past years.

The house wren was found to be common, while the white-breasted nuthatch might be called numerous; the chickadees appeared to be abundant in both branches of Sawmill Run, during the first half of September, when perhaps a dozen flocks of several individuals each would be attracted by the intruder in the course of each day's travels.

Of the thrush family, the notes of the wood and hermit thrushes were to be heard frequently throughout the forested part of the tract, while the bluebird's flash of color was generally noticeable in walking along the roads. The robin was very abundant, especially in the runs, although several large flocks were noted in Vollenhime, toward the end of August.

*Bird Habitats.* Of the several ways of grouping birds, perhaps the most logical and convenient one for the purpose of a general report is by habitats. Some birds are practically always found in one type of surroundings, others may occur in a number of diverse habitats, but it will be found on close observation that every bird generally has some preference; it will be found in one type of surroundings more often than in any other. The habitats here listed have, with one exception, been based on those used by Mr. Saunders in his grouping of the birds of the Allegany State Park (1923).

**FOREST HABITAT.** The typical forest habitat may be further subdivided into three parts, namely, the forest trees proper, the forest undergrowth and the forest floor.

Under the first of these subdivisions are included the trunk, the side branches and the crown. Deciduous trees are by far the most abundant in the tract, for although a century ago the hills were clothed in a growth of white pine with a sprinkling of hemlock, the more easily utilized conifers have been cut off so thoroughly that over most of the area hemlock cannot be called common (at least when comparison is made with some of the hardwoods, such as the maples or oaks) and white pine is rather rare, occurring naturally only as a few scattered trees. The most common hardwood trees are the hard and soft maples (*Acer saccharum* and *A. rubrum*),

white ash (*Fraxinus americana*), basswood (*Tilia americana*), chestnut (*Castanea dentata*), black, and yellow birch (*Betula lenta* and *B. lutea*), the oaks (*Quercus borealis*, *Q. velutina*, *Q. alba*, and *Q. montana*), pignut hickory (*Carya glabra*), cucumber tree (*Magnolia acuminata*) and others. The birds observed in this type of habitat are:

- |                               |                                  |
|-------------------------------|----------------------------------|
| 1. Green Heron                | 30. Towhee                       |
| 2. Mourning Dove              | 31. Rose-breasted Grosbeak       |
| 3. Marsh Hawk                 | 32. Indigo Bunting               |
| 4. Red-tailed Hawk            | 33. Scarlet Tanager              |
| 5. Red-shouldered Hawk        | 34. Cedar Waxwing                |
| 6. Sparrow Hawk (flying over) | 35. Red-eyed Vireo               |
| 7. Screech Owl                | 36. Warbling Vireo               |
| 8. Yellow-billed Cuckoo       | 37. Yellow-throated Vireo        |
| 9. Black-billed Cuckoo        | 38. Black and White Warbler      |
| 10. Belted Kingfisher         | 39. Northern Parula Warbler      |
| 11. Hairy Woodpecker          | 40. Black-throated Blue Warbler  |
| 12. Downy Woodpecker          | 41. Magnolia Warbler             |
| 13. Northern Flicker          | 42. Chestnut-sided Warbler       |
| 14. Whip-poor-will            | 43. Blackburnian Warbler         |
| 15. Ruby-throated Hummingbird | 44. Black-throated Green Warbler |
| 16. Crested Flycatcher        | 45. Pine Warbler                 |
| 17. Phoebe                    | 46. Oven-bird                    |
| 18. Wood Pewee                | 47. Mourning Warbler             |
| 19. Least Flycatcher          | 48. Hooded Warbler               |
| 20. Blue Jay                  | 49. Canada Warbler               |
| 21. Crow                      | 50. Redstart                     |
| 22. Red-winged Blackbird      | 51. House Wren                   |
| 23. Baltimore Oriole          | 52. White-breasted Nuthatch      |
| 24. Purple Finch              | 53. Chickadee                    |
| 25. Goldfinch                 | 54. Wood Thrush                  |
| 26. Vesper Sparrow            | 55. Veery                        |
| 27. Chipping Sparrow          | 56. Hermit Thrush                |
| 28. Slate-colored Junco       | 57. Robin                        |
| 29. Song Sparrow              |                                  |

In the forest undergrowth is included all growth under the trees except the actual ground cover such as herbaceous plants and mosses, and includes seedlings of the forest trees themselves and other small trees and shrubs such as witch hazel (*Hamamelis virginiana*), flowering dogwood (*Cornus florida*), blue beech (*Carpinus caroliniana*),



blackberry and raspberry (*Rubus allegheniensis* and *R. strigosus*), shad bush or service berry (*Amelanchier canadensis*), sassafras (*Sassafras variifolium*), maple-leaved Viburnum (*V. acerifolium*), beaked hazel (*Corylus rostrata*), thimbleberry (*Rubus odoratus*), bush honeysuckle (*Lonicera diervilla*), and the striped maple (*Acer pennsylvanicum*). The birds found in this habitat were:

- |                                  |                            |
|----------------------------------|----------------------------|
| 1. Blue Jay                      | 11. Oven-bird              |
| 2. Vesper Sparrow                | 12. Mourning Warbler       |
| 3. Field Sparrow                 | 13. Maryland Yellow-throat |
| 4. Slate-colored Junco           | 14. Hooded Warbler         |
| 5. Towhee                        | 15. Canada Warbler         |
| 6. Rose-breasted Grosbeak        | 16. Redstart               |
| 7. Nashville Warbler             | 17. House Wren             |
| 8. Black-throated Blue Warbler   | 18. Chickadee              |
| 9. Chestnut-sided Warbler        | 19. Wood Thrush            |
| 10. Black-throated Green Warbler | 20. Hermit Thrush          |
|                                  | 21. Robin                  |

The forest floor (see Fig. 28) includes fallen trees and parts of trees still standing, logging refuse, ferns and many vines, creepers and other herbaceous plants. The most common of these are checkerberry or wintergreen (*Gaultheria procumbens*), partridge berry (*Mitchella repens*), white clintonia (*Clintonia umbellata*), wild or false lily of the valley (*Maianthemum canadense*), jack-in-the-pulpit (*Arisaema triphyllum*), christmas fern (*Aspidium acrostichoides*), the trilliums, mandrake (*Podophyllum peltatum*), maidenhair fern (*Adiantum pedatum*), Indian pipe (*Monotropa uniflora*), showy orchis (*Orchis spectabilis*), arbutus (*Epigaea repens*), pipsissewa (*Chimaphila umbellata*), flame lily (*Lilium philadelphicum*), the violets (*Viola canadensis*, *V. rotundifolia* and *V. pubescens*), club mosses (*Lycopodium*), false Solomon's seal (*Smilacina racemosa*), and starflower (*Trientalis americana*).

The birds of this habitat are:

- |                        |                           |
|------------------------|---------------------------|
| 1. Ruffed Grouse       | 5. Towhee                 |
| 2. Whip-poor-will      | 6. Oven-bird              |
| 3. Slate-colored Junco | 7. Maryland Yellow-throat |
| 4. Song Sparrow        | 8. Robin                  |

UPLAND THICKETS. Upland thickets are common in the tract, occurring on recently cut-over areas, one of which is shown in figure 14, where chestnut, maple, beech and oak sprouts predominate, with black birch seeding in. Thickets in abandoned or partly aban-

doned fields, once cleared for agriculture, are also found in considerable abundance. The under-stocking of pastures, especially, has resulted in partial and in some cases complete overgrowth with hawthorns (*Crataegus*), apple (*Pyrus Malus*), choke cherry and pin cherry (*Prunus virginiana* and *P. pennsylvanica*), and blue beech (*Carpinus caroliniana*).

The birds found in upland thickets are:

- |                           |                                 |
|---------------------------|---------------------------------|
| 1. Marsh Hawk             | 10. Warbling Vireo              |
| 2. Black-billed Cuckoo    | 11. Black-throated Blue Warbler |
| 3. Goldfinch              | 12. Oven-bird                   |
| 4. Savannah Sparrow       | 13. Mourning Warbler            |
| 5. Field Sparrow          | 14. Maryland Yellow-throat      |
| 6. Song Sparrow           | 15. Hooded Warbler              |
| 7. Towhee                 | 16. Catbird                     |
| 8. Rose-breasted Grosbeak | 17. Chickadee                   |
| 9. Red-eyed Vireo         |                                 |

ORCHARDS AND SHADE TREES. The open and cultivated condition of parts of the tract implies the presence of this class of habitat. Most of the roads in the tract, where traversing open fields, are but little protected by shade trees, contrary to the usual practice in New England and eastern New York, but in pastures isolated trees have been left from the original forest or have been allowed to grow up as protection for the cattle. Most houses have at least one or two shade trees near them, and small apple orchards are fairly common so that this habitat is well represented. An abandoned orchard in State Line Run is pictured in figure 29. The trees usually occurring in this classification are sugar and red maples (*Acer saccharum* and *A. rubrum*), elm (*Ulmus americana*), apple (*Pyrus Malus*), red and white oaks (*Quercus borealis* and *Q. alba*), basswood (*Tilia americana*), butternut (*Juglans cinerea*), shag-bark and pignut hickories (*Carya ovata* and *C. glabra*), and hemlock (*Tsuga canadensis*).

The birds seen in the orchards and shade trees are:

- |                        |                          |
|------------------------|--------------------------|
| 1. Sparrow Hawk        | 8. Blue Jay              |
| 2. Black-billed Cuckoo | 9. Starling              |
| 3. Hairy Woodpecker    | 10. Bobolink             |
| 4. Downy Woodpecker    | 11. Red-winged Blackbird |
| 5. Flicker             | 12. Meadowlark           |
| 6. Kingbird            | 13. Baltimore Oriole     |
| 7. Least Flycatcher    | 14. American Goldfinch   |



Fig. 29. An orchard habitat in State Line Run.



Fig. 30. This marsh habitat north of Pine Hill is the home of such birds as the bittern and the great blue heron. It is now under development for use as a muskrat farm (see page 119).



Fig. 31. Shoreline and open bank habitat; lower Pierce Run.



Fig. 32. Stream thicket habitat on Sawmill Run, taken from Browns Run road bridge.



- |                      |                             |
|----------------------|-----------------------------|
| 15. English Sparrow  | 23. Warbling Vireo          |
| 16. Vesper Sparrow   | 24. Yellow Warbler          |
| 17. Chipping Sparrow | 25. Mourning Warbler        |
| 18. Song Sparrow     | 26. White-breasted Nuthatch |
| 19. Cliff Swallow    | 27. Chickadee               |
| 20. Barn Swallow     | 28. Robin                   |
| 21. Cedar Waxwing    | 29. Bluebird                |
| 22. Red-eyed Vireo   |                             |

MARSHES. Marshes, as previously stated, are almost wanting. There are many small areas of boggy ground, with perhaps a little standing water on the surface, but these are hardly large enough to be treated as distinct habitats. However, one area, shown in figure 30, about one-half mile north of the triangulation station on Pine Hill and just east of the Pine Hill-Randolph road, is several acres in extent and is a home for several species of birds peculiar to such localities. It has recently been increased in area for the purpose of attracting muskrats, by raising the water level, so that considerable numbers of dead trees are now in evidence. Directly west of this, across the Pine Hill-Randolph road, is another area also under development as a muskrat farm. When completed this also will be a marsh habitat of respectable size. It contains and is also bordered by many moisture-loving trees, but the open areas of the marsh contain cat-tail (*Typha latifolia*), sedges (*Carex* and *Cyperus*), rushes, (*Juncus*), arrow-head (*Sagittaria latifolia*), and water-plantain (*Alisma plantago-aquatica*).

The list of birds observed in the marsh habitat is short although many other species are known to occur in the Conewango Swamp, east of Randolph village, and it is probable that at times some of these feed, if they do not nest, in the smaller marshy areas north of Pine Hill. During the season of migration also various water birds undoubtedly stop here for rest and food. The species actually observed during my several visits are:

- |                     |                   |
|---------------------|-------------------|
| 1. Horned Grebe     | 7. Song Sparrow   |
| 2. Bittern          | 8. Cedar Waxwing  |
| 3. Great Blue Heron | 9. Yellow Warbler |
| 4. Kingbird         | 10. Catbird       |
| 5. Least Flycatcher | 11. Robin         |
| 6. Goldfinch        |                   |

WATER MARGINS AND LOWLAND THICKETS. (a) Shoreline and open banks include all shallow water along the shores of open

streams (see Fig. 31) or ponds and the banks themselves, whether gradually sloping or steep, sandy, gravelly, stony, or of clay. The birds frequenting this habitat (which is not common in the tract) do so either for the purpose of nesting, or of feeding upon the insects or other small animal life found in it. These birds are:

- |                      |                         |
|----------------------|-------------------------|
| 1. Bittern           | 5. Crow                 |
| 2. Green Heron       | 6. Red-winged Blackbird |
| 3. Spotted Sandpiper | 7. Bronzed Grackle      |
| 4. Belter Kingfisher | 8. Cedar Waxwing        |

(b) Stream Thickets are much more abundant than the preceding type (a), since the latter is found only where all the willows and other trees and shrubs have been browsed by cattle, or cleared away from the banks by man. Fortunately for the conservation of water and the protection of the banks, this has not often been done even where cultivated fields border the stream. Usually there are trees, but no true forest, and most of the vegetation may be classed as thicket, with a tangle of vines and herbaceous plants. Such a habitat on Sawmill Run is shown in figure 32. The trees are chiefly elm (*Ulmus americana*), red maple (*Acer rubrum*), yellow birch (*Betula lutea*), willows (*Salix*) and hemlocks (*Tsuga canadensis*). Shrubs include elders (*Sambucus canadensis* and *S. racemosus*), alders (*Alnus rugosa* and *A. incana*), raspberry and blackberry (*Rubus*), and wild rose (*Rosa sp.*, probably *virginiana*). Under the heading of vines are grapes (*Vitis*) and virgin's bower (*Clematis virginiana*). A few of the many herbaceous plants are sedges (*Carex* and *Cyperus*), pale and spotted jewelweed (*Impatiens pallida* and *I. fulva*), bee balm (*Monarda didyma*), ferns, nettles (*Urtica*), American white hellebore (*Viratrum viride*), and lilies (*Lilium canadense* and *L. superbum*).

The birds observed in this habitat are:

- |                              |                            |
|------------------------------|----------------------------|
| 1. Green Heron               | 11. Song Sparrow           |
| 2. Spotted Sandpiper         | 12. Rose-breasted Grosbeak |
| 3. Downy Woodpecker          | 13. Cedar Waxwing          |
| 4. Ruby-throated Hummingbird | 14. Yellow Warbler         |
| 5. Wood Pewee                | 15. Maryland Yellow-throat |
| 6. Red-winged Blackbird      | 16. Canada Warbler         |
| 7. Goldfinch                 | 17. Redstart               |
| 8. Chipping Sparrow          | 18. Chickadee              |
| 9. Field Sparrow             | 19. Catbird                |
| 10. Slate-colored Junco      | 20. Veery                  |

OPEN FIELDS. This habitat is a very important one, occupying as it does the second largest acreage, and serving as the home of many species of birds important to man. Open meadows and grasslands occur mainly in the broader valleys along the lower courses of the streams (although there are several openings of large size on the tops of ridges), and in the more level territory of Bowen and Vollentine south of the village of Randolph. These areas were once covered with forest, but have been cleared. The upper slopes of many, however, were found to be too steep and with soil too poor for cultivation, and are now passing into the Upland Thicket type. Many fields, while they have lain idle for years, are too large to become stocked with woody plants in such a relatively short time; they are covered with short grasses and are poor in bird life. The lower meadows, however, are either used for hay or have been plowed and sown to oats, wheat, buckwheat, or planted to corn or other crops.

The birds observed in or above the open fields are :

- |                               |                          |
|-------------------------------|--------------------------|
| 1. Semi-palmated Plover       | 20. Red-winged Blackbird |
| 2. Spotted Sandpiper          | 21. Meadowlark           |
| 3. Killdeer                   | 22. Goldfinch            |
| 4. Mourning Dove              | 23. English Sparrow      |
| 5. Marsh Hawk                 | 24. Vesper Sparrow       |
| 6. Sharp-shinned Hawk         | 25. Savannah Sparrow     |
| 7. Sparrow Hawk               | 26. Chipping Sparrow     |
| 8. Red-tailed Hawk            | 27. Field Sparrow        |
| 9. Hairy Woodpecker           | 28. Slate-colored Junco  |
| 10. Northern Flicker          | 29. Song Sparrow         |
| 11. Night Hawk                | 30. Towhee               |
| 12. Chimney Swift             | 31. Cliff Swallow        |
| 13. Ruby-throated Hummingbird | 32. Barn Swallow         |
| 14. Kingbird                  | 33. Bank Swallow         |
| 15. Least Flycatcher          | 34. Rough-winged Swallow |
| 16. Blue Jay                  | 35. Cedar Waxwing        |
| 17. Crow                      | 36. Yellow Warbler       |
| 18. Bobolink                  | 37. Catbird              |
| 19. Cowbird                   | 38. Robin                |

BIRDS ABOUT BUILDINGS. Some birds either find protection from their natural enemies or discover more convenient nesting sites about the habitations of man: in houses, barns, sheds or under bridges. Some birds as the swallows, seem to prefer buildings

which are in use, probably because of the greater number of insects to be found here, while others, as the robin and the phoebe, usually choose abandoned dwellings and barns, or such structures as bridges, where man will not be so likely to disturb their nests. Both used and abandoned buildings are well distributed throughout the tract. The birds observed about such places are:

- |                         |                      |
|-------------------------|----------------------|
| 1. Marsh Hawk           | 12. Savannah Sparrow |
| 2. Chimney Swift        | 13. Field Sparrow    |
| 3. Kingbird             | 14. Song Sparrow     |
| 4. Phoebe               | 15. Cliff Swallow    |
| 5. Least Flycatcher     | 16. Barn Swallow     |
| 6. Blue Jay             | 17. Cedar Waxwing    |
| 7. Starling             | 18. House Wren       |
| 8. Cowbird              | 19. Chickadee        |
| 9. Red-winged Blackbird | 20. Robin            |
| 10. English Sparrow     | 21. Bluebird         |
| 11. Vesper Sparrow      |                      |

ROADSIDE HABITAT. A last and perhaps less distinct habitat has been added for the convenience of those who have neither time nor inclination to wander from the highways. The term has here been restricted so as to apply only to such roads as are shown on the topographic map, either as primary or secondary roads. The inclusion of logging and other roads and lanes would considerably broaden the scope and would result in a larger list of birds that might be observed in this habitat, but such roads are usually more or less temporary and so are not included here. The birds which may be seen or whose notes may be heard in the Roadside Habitat necessarily include many which do not nest within the right-of-way, but which spend considerable time here for the purpose of procuring food.

The habitat has been divided into two parts: open roadsides, and those with considerable brush growing down to the very edge of the roadbed. These have been called, respectively, Open Roadside and Thicket-bordered Roadside Habitats. Both are numerous throughout the tract and, the observant visitor may, without leaving the roads, see a good many, although by no means all, of the birds to be found on the area as a whole.

(a) The Open Roadside Habitat, usually merges with the Open Field type, although its extent is considerably increased by including shade trees (if not of the thicket type), bridges, etc., within the right-of-way (see Fig. 33). The most prominent of the birds of this habitat are those which live on or close to the ground, such as



sparrows; birds of the air, such as swallows; and flycatchers, which require an unobstructed view and capture their insect food by sallying forth into the air from some perch, such as a telephone pole or its wires, a fence, or exposed tree or bush. The list of birds observed in this environment includes:

- |                          |                          |
|--------------------------|--------------------------|
| 1. Semi-palmated Plover  | 17. Chipping Sparrow     |
| 2. Spotted Sandpiper     | 18. Slate-colored Junco  |
| 3. Killdeer              | 19. Song Sparrow         |
| 4. Red-tailed Hawk       | 20. Indigo Bunting       |
| 5. Nighthawk             | 21. Cliff Swallow        |
| 6. Chimney Swift         | 22. Barn Swallow         |
| 7. Kingbird              | 23. Bank Swallow         |
| 8. Phoebe                | 24. Rough-winged Swallow |
| 9. Least Flycatcher      | 25. Cedar Waxwing        |
| 10. Blue Jay             | 26. Yellow Warbler       |
| 11. Crow                 | 27. Mourning Warbler     |
| 12. Red-winged Blackbird | 28. Catbird              |
| 13. Goldfinch            | 29. House Wren           |
| 14. English Sparrow      | 30. Chickadee            |
| 15. Vesper Sparrow       | 31. Robin                |
| 16. Savannah Sparrow     | 32. Bluebird             |

(b) The Thicket-bordered Habitat, on the other hand, includes all roads which cannot properly be termed bordered by open fields, but are edged by shrubs such as wild cherry (*Prunus pumila*, *P. serotina* and *P. virginiana*), shad bush or service berry (*Amelanchier canadensis*), or the seedlings of the shade or forest trees which may or may not stand above this growth. A typical view, taken in Hotchkiss Hollow, is shown in figure 34. The birds are as follows:

- |                        |                                 |
|------------------------|---------------------------------|
| 1. Ruffed Grouse       | 9. Slate-colored Junco          |
| 2. Marsh Hawk          | 10. Indigo Bunting              |
| 3. Black-billed Cuckoo | 11. Black-throated Blue Warbler |
| 4. Northern Flicker    | 12. Mourning Warbler            |
| 5. Chimney Swift       | 13. Maryland Yellow-throat      |
| 6. Blue Jay            | 14. Canada Warbler              |
| 7. Crow                | 15. Catbird                     |
| 8. Goldfinch           | 16. Chickadee                   |

**List of Birds Found in the Tract.** The following list includes only those birds which I actually found in the tract. It is supple-



Fig. 33. The open roadside habitat is the home of swallows, flycatchers and sparrows.



Fig. 34. The thicket-bordered roadside; in this case, along the road in Hotchkiss Hollow.

mented, however, by lists of birds found by others either within the tract proper or in its vicinity.

1. Horned Grebe *Colymbus auritus* Linn.
2. American Bittern *Botaurus lentiginosus* (Montag.)
3. Great Blue Heron *Ardea herodias herodias* Linn.
4. Green Heron *Butorides virescens virescens* (Linn.)
5. Woodcock *Philohela minor* (Gmel.)
6. Spotted Sandpiper *Actitis macularia* (Linn.)
7. Killdeer *Oxyechus vociferus* (Linn.)
8. Semi-palmated Plover *Ægialitis semipalmata* (Bonap.)
9. Ruffed Grouse *Bonasa umbellus* (Linn.)
10. Mourning Dove *Zenaidura macroura carolinensis* (Linn.)
11. Marsh Hawk *Circus hudsonius* (Linn.)
12. Sharp-shinned Hawk *Accipiter velox* (Wils.)
13. Cooper's Hawk *Accipiter cooperi* (Bonap.)
14. Red-tailed Hawk *Buteo borealis borealis* (Gmel.)
15. Red-shouldered Hawk *Buteo lineatus lineatus* (Gmel.)
16. Sparrow Hawk *Falco sparverius sparverius* Linn.
17. Screech Owl *Otus asio asio* (Linn.)
18. Yellow-billed Cuckoo *Coccyzus americanus americanus* (Linn.)
19. Black-billed Cuckoo *Coccyzus erythrophthalmus* (Wils.)
20. Belted Kingfisher *Ceryle alcyon alcyon* (Linn.)
21. Hairy Woodpecker *Dryobates villosus villosus* (Linn.)
22. Downy Woodpecker *Dryobates pubescens medianus* (Swains.)
23. Northern Flicker *Colaptes auratus luteus* Bangs
24. Whip-poor-will *Antrostomus vociferus vociferus* (Wils.)
25. Nighthawk *Chordeiles virginianus virginianus* (Gmel.)
26. Chimney Swift *Chætura pelagica* (Linn.)
27. Ruby-throated Hummingbird *Archilochus colubris* (Linn.)
28. Kingbird *Tyrannus tyrannus* (Linn.)
29. Crested Flycatcher *Myiarchus crinitus* (Linn.)
30. Phœbe *Sayornis phæbe* (Lath.)
31. Wood Pewee *Myiochanes virens* (Linn.)
32. Least Flycatcher *Empidonax minimus* (W. M. & S. F. Baird)
33. Blue Jay *Cyanocitta cristata cristata* (Linn.)
34. Crow *Corvus brachyrhynchos brachyrhynchos* Brehm
35. Starling *Sturnus vulgaris* Linn.

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|------------------------------------|---|
| 36. Bobolink                       | <i>Dolichonyx oryzivorus</i> (Linn.)                    |
| 37. Cowbird                        | <i>Molothrus ater ater</i> (Bodd.)                      |
| 38. Red-winged Blackbird           | <i>Agelaius phœniceus phœniceus</i> (Linn.)             |
| 39. Meadowlark                     | <i>Sturnella magna magna</i> (Linn.)                    |
| 40. Baltimore Oriole               | <i>Icterus galbula</i> (Linn.)                          |
| 41. Bronzed Grackle                | <i>Quiscalus quiscula æneus</i> Ridgw.                  |
| 42. Purple Finch.                  | <i>Carpodacus purpureus purpureus</i> (Gmel.)           |
| 43. Goldfinch                      | <i>Astragalinus tristis tristis</i> (Linn.)             |
| 44. English Sparrow                | <i>Passer domesticus</i> (Linn.)                        |
| 45. Vesper Sparrow                 | <i>Poæcetes gramineus gramineus</i> (Gmel.)             |
| 46. Savannah Sparrow               | <i>Passerculus sandwichensis savanna</i><br>(Wils.)     |
| 47. Chipping Sparrow               | <i>Spizella passerina passerina</i> (Bech.)             |
| 48. Field Sparrow                  | <i>Spizella pusilla pusilla</i> (Wils.)                 |
| 49. Slate-colored Junco            | <i>Junco hyemalis hyemalis</i> (Linn.)                  |
| 50. Song Sparrow                   | <i>Melospiza melodia melodia</i> (Wils.)                |
| 51. Towee                          | <i>Pipilo erythrophthalmus erythrophthalmus</i> (Linn.) |
| 52. Rose-breasted Gros-<br>beak    | <i>Zamelodia ludoviciana</i> (Linn.)                    |
| 53. Indigo Bunting                 | <i>Passerina cyanea</i> (Linn.)                         |
| 54. Scarlet Tanager                | <i>Piranga erythromelas</i> Vieill.                     |
| 55. Cliff Swallow                  | <i>Petrochelidon lunifrons lunifrons</i> (Say)          |
| 56. Barn Swallow                   | <i>Hirundo erythrogastra</i> Bodd.                      |
| 57. Bank Swallow                   | <i>Riparia riparia</i> (Linn.)                          |
| 58. Rough-winged Swal-<br>low      | <i>Stelgidopteryx serripennis</i> (Aud.)                |
| 59. Cedar Waxwing                  | <i>Bombycilla cedrorum</i> Vieill.                      |
| 60. Red-eyed Vireo                 | <i>Vireosylva olivacea</i> (Linn.)                      |
| 61. Warbling Vireo                 | <i>Vireosylva gilva gilva</i> (Vieill.)                 |
| 62. Yellow-throated Vireo          | <i>Lanivireo flavifrons</i> (Vieill.)                   |
| 63. Black and White War-<br>bler   | <i>Mniotilta varia</i> (Linn.)                          |
| 54. Nashville Warbler              | <i>Vermivora ruficapilla ruficapilla</i><br>(Wils.)     |
| 65. Northern Parula War-<br>bler   | <i>Compsothlypis americana pusilla</i> (Wils.)          |
| 66. Yellow Warbler                 | <i>Dendroica æstiva æstiva</i> (Gmel.)                  |
| 67. Black-throated Blue<br>Warbler | <i>Dendroica caerulescens caerulescens</i><br>(Gmel.)   |
| 68. Magnolia Warbler               | <i>Dendroica magnolia</i> (Wils.)                       |



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|----------------------------------|--|
| 69. Chestnut-sided Warbler       | <i>Dendroica pensylvanica</i> (Linn.)              |
| 70. Blackburnian Warbler         | <i>Dendroica fusca</i> (Mull.)                     |
| 71. Black-throated Green Warbler | <i>Dendroica virens</i> (Gmel.)                    |
| 72. Pine Warbler                 | <i>Dendroica vigorsii</i> (Aud.)                   |
| 73. Oven-bird                    | <i>Sciurus aurocapillus</i> (Linn.)                |
| 74. Mourning Warbler             | <i>Oporornis Philadelphia</i> (Wils.)              |
| 75. Maryland Yellow-throat       | <i>Geothlypis trichas trichas</i> (Linn.)          |
| 76. Hooded Warbler               | <i>Wilsonia citrina</i> (Bodd.)                    |
| 77. Canada Warbler               | <i>Wilsonia canadensis</i> (Linn.)                 |
| 78. Redstart                     | <i>Setophaga ruticilla</i> (Linn.)                 |
| 79. Catbird                      | <i>Dumetella carolinensis</i> (Linn.)              |
| 80. House Wren                   | <i>Troglodytes ædon ædon</i> Vieill.               |
| 81. White-breasted Nuthatch      | <i>Sitta carolinensis carolinensis</i> Lath.       |
| 82. Chickadee                    | <i>Parus atricapillus atricapillus</i> (Linn.)     |
| 83. Wood Thrush                  | <i>Hylocichla mustelina</i> (Gmel.)                |
| 84. Veery                        | <i>Hylocichla fuscescens fuscescens</i> (Steph.)   |
| 85. Hermit Thrush                | <i>Hylocichla guttata pallasi</i> (Cab.)           |
| 86. Robin                        | <i>Planesticus migratorius migratorius</i> (Linn.) |
| 87. Bluebird                     | <i>Sialia sialis sialis</i> (Linn.)                |

Birds observed within one mile of the boundary of the tract, but not seen within the tract proper are:

- |                             |  |
|-----------------------------|--|
| 1. Yellow-bellied Sapsucker | <i>Sphyrapicus varius varius</i> (Linn.) |
| 2. Brown Thrasher           | <i>Toxostoma rufum</i> (Linn.)           |

The following birds, although not seen by me, were found in the Allegany State Park or on the Allegany Indian Reservation, by Mr. Aretas A. Saunders in 1921, and because of the close proximity of the two areas these will probably be found also in the tract here concerned:

- |                 |   |
|-----------------|---|
| 1. Herring Gull | <i>Larus argentatus</i> Pont.           |
| 2. Black Duck   | <i>Anas rubripes</i> Brewst.            |
| 3. Sora         | <i>Porzana carolina</i> (Linn.)         |
| 4. Bald Eagle   | <i>Haliaeetus leucocephalus</i> (Linn.) |
| 5. Barred Owl.  | <i>Strix varia varia</i> Barton         |

- |                          |   |
|--------------------------|---|
| 6. Northern Pileated     |   |
| Woodpecker               | <i>Phlacotomus pilcatus abieticola</i> (Bangs)  |
| 7. Red-headed Wood-      |   |
| pecker                   | <i>Melanerpes erythrocephalus</i> (Linn.)       |
| 8. Prairie Horned Lark   | <i>Otocoris alpestris praticola</i> Hensh.      |
| 9. Grasshopper Sparrow   | <i>Ammodramus savannarum australis</i>          |
|                          | Mayn.   |
| 10. Cardinal             | <i>Cardinalis cardinalis cardinalis</i> (Linn.) |
| 11. Tree Swallow         | <i>Iridoprocne bicolor</i> (Vieill.)            |
| 12. Blue-headed Vireo    | <i>Lanivireo solitarius solitarius</i> (Wils.)  |
| 13. Tennessee Warbler    | <i>Vermivora peregrina</i> (Wils.)              |
| 14. Cerulean Warbler     | <i>Dendroica cerulea</i> (Wils.)                |
| 15. Northern Water-      |   |
| Thrush                   | <i>Seiurus noveboracensis noveboracensis</i>    |
|                          | (Gmel.)   |
| 16. Louisiana Water-     |   |
| Thrush                   | <i>Seiurus motacilla</i> (Vieill.)              |
| 17. Yellow-breasted Chat | <i>Icteria virens virens</i> (Linn.)            |
| 18. Winter Wren          | <i>Nannus hiemalis hiemalis</i> (Vieill.)       |
| 19. Brown Creeper        | <i>Certhia familiaris americana</i> (Bonap.)    |
| 20. Olive-backed Thrush  | <i>Hylocichla ustulata swainsoni</i> (Tschudi)  |

The following summer birds, not observed by me in the tract, nor by Mr. Saunders in the Allegany State Park, are listed by Mr. Mearl Wheeler, an ornithologist and collector of Randolph. They will probably be included in future lists:

- |                        |  |
|------------------------|--|
| 1. Least Bittern       | <i>Ixobrychus exilis</i> (Gmel.)               |
| 2. King Rail           | <i>Rallus elegans</i> Aud.                     |
| 3. Virginia Rail       | <i>Rallus virginianus</i> Linn.                |
| 4. Coot                | <i>Fulica americana</i> Gmel.                  |
| 5. Wilson Snipe        | <i>Gallinago delicata</i> (Ord.)               |
| 6. Greater Yellow-legs | <i>Totanus melanoleucus</i> (Gmel.)            |
| 7. Yellow-legs         | <i>Totanus flavipes</i> (Gmel.)                |
| 8. Goshawk             | <i>Astur atricapillus atricapillus</i> (Wils.) |
| 9. Osprey              | <i>Pandion haliaëtus carolinensis</i> (Gmel.)  |
| 10. Barn Owl           | <i>Aluco pratincola</i> (Bonap.)               |
| 11. Long-eared Owl     | <i>Asio wilsonianus</i> (Less.)                |
| 12. Great Horned Owl   | <i>Bubo virginianus virginianus</i> (Gmel.)    |
| 13. Swamp Sparrow      | <i>Melospiza georgiana</i> (Lath.)             |

## SUGGESTIONS FOR ESTABLISHMENT OF GAME AND FOREST DEMONSTRATION AREAS

**Introduction of Species.** While the introduction of exotic species in any territory is always a matter fraught with uncertainty and one that should be undertaken, if at all, only after careful consideration, the re-introduction of native species that once inhabited the tract but are now absent because of activities of man, is quite another question. When the white man first came into western New York, deer were abundant. However, with the progressive settlement of the country, clearing of the forest and continued, perhaps excessive, hunting, the deer gradually disappeared from the belt extending across southern New York, and for many years following they were practically extinct in this territory. However, due partly to later infiltration from territory to the south, particularly, and partly to the stocking of the Allegany State Park just across the Indian Reservation, the deer are beginning to re-establish themselves in the tract.

The elk was probably once an important animal of this section but has been extinct here for many decades. Undoubtedly it could be re-established, as this has been accomplished in similar sections of Pennsylvania and in the Adirondacks. There is, however, a serious objection to the introduction of elk into a comparatively small unfenced preserve. The animals are at times migratory, and the proximity of the tract to farming land makes it certain that the importation of elk would be followed by strenuous protests and bills for damaged crops from nearby parts of Cattaraugus and Chautauqua Counties.

Another former resident of this section is the wild turkey. The following was the recommendation concerning the re-stocking of the Allegany State Park with Wild Turkey made by Mr. Saunders\* after his investigative work of 1921, and since the two tracts are quite similar in character and are almost contiguous, the matter is of especial interest and is quoted verbatim.

"While there is good ground for objection to the introduction of foreign game birds, there ought to be none to the introduction of species formerly native in the region. The Wild Turkey undoubtedly occurred here many years ago. I am not aware that any attempt has ever been made to introduce this species as a game bird in regions where it was formerly common. [Pennsylvania has, however, done

\* Saunders '23: The Summer Birds of Allegany State Park. Roosevelt Wild Life Bulletin, Vol. 1, pp. 235-354.

much work in bringing back the turkey and it is now common in a few localities of that state. The 1922-24 report of the Board of Game Commissioners of Pennsylvania indicate that 5,400 wild turkeys were legally killed there in 1922. Figures for the following year were incomplete at the time of issuance of the report, but over 6,000 birds had been reported to that date.] It is now rare in most regions to which it was formerly indigenous, and perhaps is in danger of extermination. Its preservation for the future should be of as much value and interest as the preservation of bison and elk. It might be difficult, and undoubtedly would be expensive, to obtain a stock of these birds. The stock should be obtained from a region as nearly like the Park as possible, one where there are deep snows in winter, that the birds may be accustomed to living through a hard season. Perhaps such conditions will be found in the higher parts of the southern Appalachians. The birds should of course not be hunted for many years, or until their introduction has proved wholly successful. The food habits of the Wild Turkey should be studied, particularly during the winter, and the birds fed when necessary during the first few years at least. There is as much reason to expect the introduction of this bird to be successful as that of the Pheasant; and to the American nature lover its re-establishment in its former haunts should be of great interest and a source of just pride."

The bird is a most valuable one from the viewpoint of the sportsman, and the writer believes that the outlook for its re-establishment in the Cattaraugus tract, if tried under the proper conditions and with reasonable care, is even brighter than Mr. Saunders' statements would seem to indicate.

**Improvement of Habitats.** Any tract partly wooded and partly agricultural, which might be set aside for a game preserve, is quite likely to be incapable of supporting the maximum number of game species without considerable improvement by man. But with protection and proper management such a preserve at least should support a greater quantity of game than is found on the tract under ordinary conditions. A time will come, however, sooner or later when the game as well as other wild life will have increased practically to the limits imposed by nature, the chief of which are probably food, cover, individual territory or ranging room, disease and natural enemies.

So far as food is concerned, it is probably better, if practicable, to provide natural food than to practice artificial feeding. The principle might be adopted of planting as many food plants as



possible or necessary to fill the gaps in the natural food supply which are certain to occur, either in the case of local absence of a food, or in its scarcity over a wide area. A limit will naturally be reached in the amount of planting which can thus be done, and *then*, and then only, should this food supply, if it is found inadequate, be supplemented by hand feeding. It is felt that this method will create more nearly natural conditions, and will in the long run yield the best results. There will be periods, it is true, such as in very severe winter weather and in cold, wet periods in spring, when certain species must be fed in order to prevent possible losses, but a minimum of this will probably serve to keep the game in better condition to meet the vicissitudes, and will make it wilder, resulting in better sport for the hunters.

As a general thing, planting will probably prove a rather discouraging undertaking, as it is expensive and not immediately effective. However, the work can be undertaken gradually, a small amount planted at a time, depending chiefly upon natural propagation. Browse and other vegetation acceptable to herbivorous game are abundant, so that there would be no need of soon making further provision for these. But many smaller plants which would furnish food for grouse in winter are wanting in places, so that the planting of bayberry (*Myrica*), greenbriar (*Smilax hispida*), climbing bitter-sweet (*Celastrus scandens*), barberry (*Berberis*), and mountain ash (*Sorbus*) would greatly improve the present food situation for the ruffed grouse. Rose hips are relished by many birds, and since the wild rose is very easily propagated it should be more abundant in the tract than it is at present. Oaks are not numerous in the northern part of the tract, so that a few groves planted now would aid in a better distribution of the gray squirrels in years to come. Water lilies and other aquatic plants are scarce.

In planting, the general policy should be, perhaps, to plant small areas at well distributed points as needed, in patches large enough to insure the perpetuation of the planted species. The principle would be merely to start the plants in such patches as nuclei and allow nature to continue their distribution. This would probably be more successful, and much cheaper than a more elaborate planting campaign. It should be borne in mind, however, that there is already enough natural food on the tract to provide for a very considerable increase in practically all the representative species of wild life; therefore the problem would really be to take care of the future well in advance of the time when more food will be needed.

It has been previously noted that the tract is deficient in swamp

and marsh habitats, and that there are found only two very small artificial ponds (not shown on the map). It would be desirable to have a small lake, both for the fishing it might provide as well as for the additional variety of plants and of animal life which would result. With this end in view further investigation might be made to establish the practicability of the following suggestion: that Little Conewango Creek be dammed about a quarter-mile south of the Corbett Hill School, so as to flood the entire round depression between Pine and Corbett Hills. This, I believe, is the only spot in the entire tract where by means of a small dam it would be possible to produce an artificial lake of desirable size.

The stream which would be the source of water supply is probably not large enough for the size of the lake I have in mind, about a square mile in area, but it might be possible to supplement this supply by tapping an underground source.

Many areas of the tract at present lack the low cover which is so essential for protection of many animal species. The best natural cover is now provided by hemlocks; consequently the planting of this species in a considerable number of clumps ranging in size from a quarter to a half-acre each, would be advisable. A little underplanting of some of the more open stands may be beneficial, and spruce and hemlock, with white or red pine, may be planted in parts of the open fields. More cover, as well as considerable food, will also be provided by a growth of old field type of vegetation. To this end, grazing should be stopped in such old pastures as may be springing up to thorn apple, witch hazel, etc., and in this way the reversion to forest growth would be hastened. The effect of grazing in keeping down underbrush is illustrated in figure 35, an extreme case noted north of Pine Hill. Sheep in this instance have stripped practically all the underbrush as well as the herbaceous plants, in the foreground, up to the height of their reach, leaving only woody growth, while beyond the fence in the background is a fine grouse and snowshoe rabbit area, a dense old field growth.

**Vermin Control.** Ever since man has taken a protective interest in game, the question of regulation of the enemies of desirable species has been a mooted question. If we had to consider only the game animals and birds, and if other conditions would remain undisturbed, there would be no argument over the eradication of vermin. However, few may presume to predict the series of consequences which may arise as a result of the elimination of even an apparently insignificant species. If this species is naturally preyed upon by

another species, the latter will be forced to find another source of food, and the diminution of this will in turn react upon other species, just as motion may be transmitted to a series of objects by the movement of a single member. In mechanics, the sum of the movements can be calculated exactly, but our knowledge of living things will be for a long time too incomplete to allow us to predict with certainty the result of the extermination even of a single species in the animal kingdom. At the present time we can only experiment in the control of certain predatory species; but since man has never been able to evolve a new species, the deliberate extermination of one is always to be condemned; it can never be replaced.

Bringing the discussion down to the concrete, we cannot safely eradicate the foxes from the tract, for although they do, it is true, destroy more or less game, we can not tell what the actual result will be upon other animals. The fox is an important factor in preserving the balance in the number of mice, which, if all checks were removed, would soon overrun the territory, causing much damage to farm crops and to forest reproduction. The possible simultaneous increase in the number of rabbits would have the same effect, and in addition the probable overcrowding of these would favor the spread of any diseases to which these animals might be susceptible. The destruction of the wolves, coyotes and mountain lions, which were natural checks on the mule deer of the Kaibab National Forest, has resulted in such an increase in the deer herd that its available food supply is threatened with exhaustion and the animals are in danger of starving *each other* to death. This is an extreme case, of course, and no similar result would be expected to follow the eradication of the natural enemies of the game in the Cattaraugus tract because of different conditions, but it nevertheless indicates the presence of the fact that man cannot carelessly tamper with the balance of nature without running the risk of creating unlooked-for and undesirable consequences.

The result of an increase in the game birds and mammals may, however, be expected to result in a corresponding increase in the number of their natural enemies. Predacious animals, attracted by better food conditions, may be expected to come in from surrounding territory. The conditions within a tract which favor the multiplication of one kind of animal will also favor another, so that there would accordingly be many other species aside from game animals for the predatory forms to prey upon. The relative effect of "vermin" upon game, therefore, may not actually be any greater inside such a refuge than it is outside. Measures for the control

of predatory species in a game refuge, should be made effective only after an investigation by competent persons has established, as nearly as possible, the true facts; and any such methods as poison campaigns are too dangerous to be practiced by any except most competent and responsible individuals.

The fox is probably the greatest check on the game species of the tract, although the weasel, due to its abundance, may also be important, but satisfactory evidence is lacking. Further studies, especially during the winter, may reveal enough evidence to warrant a reduction in their numbers. The great horned owl is without question the most destructive of the raptorial birds, and the goshawk a close second, when it visits the tract in considerable numbers in the winter season. The Cooper's and the sharp-shinned hawks are hardly sufficiently common to require special action in conditions such as those of the tract in question. But conditions are ever subject to change and no sweeping statements can be made to cover situations that might arise in the future.

**Game Refuge.** Even in a game preserve where hunting is carefully regulated a true game refuge or sanctuary is ordinarily established in which hunting is absolutely prohibited. The purpose of the sanctuary is of course to insure a nucleus of breeding stock. The refuge preferably should be a block of land of regular shape (at least without long, narrow projections) generously supplied with all the requirements of successful existence for the species it is desired to protect. It should be plainly marked and posted against all hunting or unnecessary disturbance at all times. The Pennsylvania system of State Game Refuges has proved very successful in that state. The main points of this system are that no refuge shall exceed in area one-half of the total area of the State forest on which it is located; it shall be located not less than twenty-five miles from any other State Game Refuge, and it shall not exceed ten miles in its greatest transverse dimension. The refuge shall be surrounded by a well-defined fire line, road or other clear strip of land, and by at least one wire at the boundary thereof. Along the boundary, not over one hundred and fifty yards apart, are posted notices to the effect that no hunting is allowed, and giving other rules and regulations. To facilitate patrolling, no trespassing whatever is allowed during the open-season months of October, November and December. A similar sanctuary I would suggest for our hypothetical game preserve in the Cattaraugus tract, and the location of such a refuge may next be considered.



For an area the size of this tract only one refuge would be required. This should be as centrally located as possible, in order that the surplus animals, the result of breeding, may invade and re-stock the surrounding territory in all directions, if possible and desirable. Taking into consideration the qualifications such a refuge should have for the game species most likely to be cultivated in the tract, it is believed that the ridge between the North Branch of Bone Run and Phillips Brook, from Bone Run north to the Randolph-South Valley town line, would meet these requirements. Except at its southern end, this area is more remote from farms than any other similar section of the tract. With the exception of the northern one, all the boundaries are already plainly marked by roads, which would also serve as open fire lines. The north boundary would require clearing. The area is of sufficient size and yet not out of proportion to the total acreage of the tract. Food and cover (see habitat descriptions) are both ample, and would be sufficient for some years to come. Although the eastern section sloping down to Phillips Brook, is at present deficient in undergrowth, it could be much improved by making a heavy selection cutting of all merchantable trees except the beech which should be left because of the value of its seeds as food for game species.

A game refuge to be effective requires a resident caretaker or keeper. His duties would include not only the necessary police work, but also such activities as planting, winter feeding, fire patrol, vermin control, keeping of records, and in fact any other duties which the best interests of the game and the refuge might require, and which the keeper (with the help of assistants, if necessary) might be able to perform.

**Effect of a Game Refuge upon Surrounding Territory.** The establishment of a game refuge in proximity to a farming district may of course have certain undesirable possibilities, one of which is that certain game animals may invade the farmers' fields and cause damage of one kind or another. The time when such invasions would be likely to occur is during the closed season; but in reality there would probably be little cause for concern on this score. A refuge is usually surrounded by open hunting territory of sufficient proportional extent to preclude any very probable excursion of game animals beyond its limits even in the closed season, as the animals are unlikely to stray far beyond the limits of their habitats. If such should, however, occur, there would doubtless be no great difficulty in finding a solution. Take, for example, the case of deer, as men-

tioned in the Biennial Report of the Board of Game Commissioners of Pennsylvania for 1922-1924, p. 7:

"The situation with reference to Deer is becoming somewhat serious in certain agricultural sections. Female Deer have increased so rapidly in sections stocked early in the history of the Board and are encroaching upon surrounding farms to an extent that is disconcerting, to say the least. This condition has been aggravated through the protection of the forests against fires, with the result that undergrowth has been choked out in certain areas and the Deer are compelled to depend upon surrounding territory for suitable forage. Believing that constructive efforts to supply more feed for game, especially Deer, will help game decidedly, and also remove the cause of complaint in many instances, the Board has instituted an intensive food planting campaign.

"It is the opinion of the Board that no arrangement for paying damages for crops destroyed by Deer will work out satisfactorily and probably the only safe plan will be to open the season for female Deer in sections where necessary to relieve conditions after the close of the season for male Deer . . ."

In a territory managed purely as a game preserve, there is not, furthermore, an excessive acreage of thick timber in which the underbrush has been killed out, for cuttings are made with the purpose of providing food and cover for the wild life. Therefore there would hardly be so much trouble in this case as in purely commercial forest areas where such management cannot be practiced. It is my opinion that because of the large population within a radius of a comparatively few miles any special check on deer would hardly be needed. Other game species than the deer would not be likely to prove troublesome, at least for many years.

The primary beneficial effect of the establishment of a tract as a game preserve would be the re-populating of a great deal of waste land *outside* of the boundaries of the tract with certain desirable and less troublesome small game species. Such a center of propagation and distribution of wild life is needed in many sections of the State where hunting has long been a discouraging sport.

The predatory species would, in all probability, have no more effect in the surrounding districts than they do at present, because control measures would regulate their numbers.

**Fire Protection.** Simultaneously with the establishment of an area and the formulation of plans for its management as a game



Fig. 35. The effect of sheep grazing in keeping down undergrowth. In the background, beyond the fence, the animals have been excluded and there is a dense growth of maple and other hardwoods.



Fig. 36. Who picknicked in the North Branch of Bone Run about three miles north from the Bone Run road, at noon on August 26, 1926, and left before putting out their fire?





Fig. 37. Sheet erosion in Sawmill Run.



Fig. 38. Gullying in Bone Run. This is the most common form of erosion on the bare hillsides. This example was about 175 feet long from the head to the lower end in the foreground.



preserve, there should be drawn up adequate plans for its protection from fire. All carefully laid plans and cherished hopes for forest growth and game conservation would very largely go by the board should a devastating fire occur. Probably nothing else could produce such a complete disruption in the progress of a tract toward the end in view. Therefore it is of the utmost importance that fire be prevented, or that means be at hand for its speedy control if it should occur.

The most important part of prevention is an adequate observation system supplemented and aided by a patrol system. A general lookout over the entire tract should be kept throughout the potential fire season, which usually lasts from the time the ground litter dries out in the spring until the coming of snow. This watch is most effectively kept from a steel tower of the type common throughout the Northeast and which requires no description here.

The topography of the tract is a little unfortunate from the standpoint of good observation. The long ridges, of the same general height, obstruct the view into the bottoms of the runs from any point that can be selected. It is therefore not possible to obtain direct observation and a tower would need to be located as close as possible to the center of the tract, consistent with securing the best elevation. The requirements are fairly well met at the site of the triangulation station north of Carr Corners. This is the highest point in the area (2180 feet above sea level) and indeed is almost the highest point in Cattaraugus County. The site is easily accessible for teams; it is level and free from rocks so that actual construction of a tower would be relatively simple. The present forest growth has surrounded the old survey tripod at the triangulation station, but a 50-foot tower would probably remain above the tree-tops until the maturity of the stand. The observer should be aided during hazardous fire weather by a patrol; one warden mounted on a motorcycle should prove sufficient. A telephone system is also essential, serving as a means of communication between the lookout and the patrol, or between the lookout and the fire-fighting force. Reports from residents of the tract and of nearby territory might also be instantly obtained by such means.

Fire warning signs should be posted at frequent intervals along the roads and especially at all the entrances to such a tract, and during unusual dry periods all visitors except those going directly through the tract may be refused entrance. The need for education on fire hazards is suggested by figure 36. A party of picnickers had neglected to put out their fire when leaving, and at the moment of

my arrival the wind was blowing live sparks beyond the circle of ashes and into the grass.

As further details in an effective fire-fighting system, boxes containing kits of fire-fighting tools might be distributed over the area, at strategic points, preferably at road junctions; and at intermediate points where these are a considerable distance apart telephones might be located at the same time. A gasoline-operated fire pump is another important modern piece of equipment, which when mounted on a motor truck can be taken to almost any part of the tract in very short time. It is especially valuable where available hands are few. Small hand pumps are valuable for small or incipient fires and are less expensive than the other type mentioned. They alone might be sufficient in some situations and could be distributed in the tool boxes.

The present road system, by way of example, provides the basis for a scheme of fire lines which might be further extended. The general plan would be to lay out lines running across the ridges between the roads at intervals of about a mile; these lines then to be cleared for a width of twenty feet of all underbrush and leaning snags. No green timber should be cut since this serves to keep down brush. Preferably, old logging roads should be used as the basis for such fire lines, and in many cases these roads would be found satisfactorily spaced for the purpose. The fire lines could in case of necessity be routes of easy travel for the fire fighters or could be the basis for the cleared lines for fire-breaks.

**Reforestation.** The subject of reforestation is both an important and a delicate part of any suggestions that may be made for putting into operation as a game preserve such a tract as the area in Cattaraugus County. From the viewpoint of the average sportsman, commercial forestry in a game tract should not be considered except in places or parts of the tract where it can be practiced without detriment to the game. Ordinary plantations are usually of conifers, and have less value for game than does a mixed stand of hardwoods and conifers; while they furnish cover for certain species of game, especially in winter, they provide only a limited amount of food. However, a great deal of investigative work is yet to be done before we can safely make rules regarding the practice of commercial forestry in its relation to the requirements of game animals. Some of the questions concerning this relation may be indicated.

What, for example, should be the size and location of cutting areas with respect to each other? There is, conceivably, an optimum

size of opening that can be created in clear cutting systems, which will allow the entire tract to be managed as a stand, and at the same time give protection, food and shelter to the game inhabitants. Then there are the relations of young, immature and mature timbered areas and certain game animals to be determined. In other words, should the cutting areas be situated in checkerboard fashion, as in group selection, or in some other manner? What should be the size of openings created in the strip selection method, or in clear cutting, for the best development of the game resources? What is the effect of the use of the coppice reproduction system on wild life? What is the effect of more or less disturbance by the intensive use of thinnings, improvement and other intermediate cuttings?

Again, what should be the optimum size of timber for best wild life development? It is certain that few species of animals flourish in deep virgin forest. Ruffed grouse prefer as their habitat brush land and openings filled with brush and surrounded by large timber. What should be the proportional relations of mature and immature timber for the best development of the wild life resources? These and many other questions remain to be answered, and in the meanwhile we must feel our way cautiously and make as few mistakes as possible, by keeping close to such knowledge as we already have of the requirements of the species we may wish to cultivate.

Many open areas in the tract which are at present of little use for game could be re-stocked with trees in order to protect the slopes from erosion. In planting, however, the methods used should look toward improving future wild life conditions, and it is believed that this can be accomplished without seriously reducing the value of the timber crop. It is admitted that maximal timber production can not be secured in an area where game is to be a chief consideration. The chief difficulty is the spacing. Game birds and animals find conditions poor in the usual closely-spaced plantation. In most forestry practice in this country trees are spaced six by six feet apart. A step in the proper direction for game management is indicated by the following, quoted from "Seeding and Planting," by J. W. Toumey, 1916, p. 59: "If the spacing does not exceed ten by ten feet, the stand will usually produce as much timber at maturity as the closely spaced unthinned stand. Close spacing causes the trees to clear more satisfactorily and permits the selection of the straightest and best for the final stand, as the poorer trees are taken out in the thinnings." Hence, widely spaced trees need no thinning, although at maturity they naturally yield a lower grade of lumber than do thinned stands. Wide spacing, therefore, may be

used, creating more favorable conditions for wild life, and timber may at the same time be harvested.

In the selection of species for planting, it should be kept in mind that food for the wild inhabitants is a major consideration, that cover, which in a tract like this is more than sufficient for present needs, is secondary in importance. For this reason conifers should not be planted very extensively. They might be planted to good advantage in the refuge, where thicker cover may be desirable in a few spots of perhaps an acre each. The most valuable timber species are hemlock, red pine, and white and red spruce. These conifers should be widely spaced, about ten by ten feet, and if this should prove later to be too close, thinning might be done. The white pine in the tract is vigorously attacked by the weevil (*Pissoides strobi*) and its use is probably inadvisable especially under conditions of wide spacing. The northern part of the tract and the section around Pine Hill is poor in oaks, so that some planting of both white and red oaks in patches of perhaps two acres each, spaced twelve by twelve feet, might well be done here. Old field type provides food and cover and, although almost worthless from a forestry point of view, should not be destroyed because of its value to game.

The subject of thinning deserves considerable attention. If this operation is not conducted over large areas at once, it should create very favorable conditions for wild life. Small openings, by letting in light, encourage undergrowth, although care must be exercised in this connection to prevent the deterioration of the humus and the growth of undesirable species and weeds. The principle should be that small openings, which will entirely close in five years or less, should be made each year in harmony with the schedule of the forester's management plan, over areas less than fifty acres in extent. A series of thinnings of this sort may be made as necessary and the products utilized for firewood.

In many instances cutting creates favorable conditions for game. Clearings containing slash are excellent for rabbits and the subsequent reproduction makes good habitat not only for rabbits but for grouse and other species of game which find cover and protection in the dense thickets and food in the herbaceous plants and berry briars accompanying the hardwoods. Slash, however, in large quantities also creates a fire hazard and this may offset its virtues in a game tract. A cutting schedule should be worked out, whereby there will be a certain alternation of mature and young growth with brush and newly clear-cut areas. These should be kept small, less than five acres in extent, and probably it will be found that the



group selection system will be best. Under this system, an uneven-aged stand (itself far more favorable for wild life than even-aged stands) is developed with the trees of the same age maintaining a group-wise arrangement. The size of the groups may vary greatly although with larger size, i. e., over a quarter of an acre, the stand begins to lose its uneven-age character. This "patch quilt" arrangement, when developed in a proper rotation, will give good results from the forestry viewpoint, will protect the site better than the clear-cutting method, is more applicable to extensive operations and poorer markets than is the selection method, lowers fire risk by confining slash to small, scattered areas, and creates favorable conditions for many species of game.

One dangerous effect of exposing large areas without forest cover is illustrated by figures 37 and 38. Torrential rains sometimes occur and erosion may become a factor in forest management. No extensive areas in the tract in question were found stripped of the surface vegetation and top soil, but many small patches were noted. The most common types are illustrated in the figures referred to above. An instance of the power of a stream to erode its banks was exhibited on Sawmill Run during the violent rainstorm of September 9, 1926. At a point about one mile above Onoville a nine-inch hemlock was torn from the bank; it dropped about two feet and then was carried downstream about twenty-five feet and left in an upright position in the middle of the stream. The forest, through the retarding action of the foliage and branches on falling water and through the absorbing qualities of the ground litter, is a great factor in preventing floods and consequent exposure of the mineral soil.

## CONCLUSION

For thousands of acres of idle land throughout New York State some form of forestry is apparently the only remedy that can restore it to a producing state. That part of the forest resources which consists of game (and fish) will, in more or less close conjunction with the major industry of raising tree crops, become increasingly important. The great recreational value of game, if no other consideration, should warrant the establishment of preserves on such waste land where regulated hunting shall be free to all citizens of the State, and where others besides hunters may come to enjoy the advantages of the woods. The vital part of such a preserve, the refuge, will insure to the adjacent lands a permanent source of supply of game, and an adequate system of such refuges would

constitute one more safeguard for passing on to posterity some small part at least of the wild life heritage which we have long been thoughtlessly squandering. Watched over by men whose duty it is to protect and assist the game and other species to a less precarious existence, there should develop much useful information which will bring this resource into an even more important position in the general scheme of all our natural renewable resources, through a better understanding of the principles of game management, and its relation to other human activities. With the more general appreciation of the great advantages of the public preserve, there will doubtless come about a converging of the objectives of nature-lovers, sportsmen and naturalists toward a common goal: equal opportunities for the enjoyment of our wild life, each in his own way.

In order to achieve this objective much work must be done, most of it pioneer in character. This report, covering only one tract in one part of the State, is intended to offer suggestions on the methods and general types of information which it is necessary to gather in order to ascertain the special qualifications of the territory under consideration. Studies of the physical geography, of the past cultural history, of the present wild life habitats and forests and the status of desirable or undesirable wild life species are only a few of the topics which might be suggested for consideration in the course of the field work. With these data as a basis, plans may be made for the establishment and management of the area as a game preserve and as a place for the study or enjoyment of wild life by the general public. In the report upon this tract, only a few of the most pressing and important subjects dealing with treatment of species which it is desired to increase, as well as the enemies of these, the problems of food supply, improvement of habitats, the game refuge, fire protection, etc., have been treated, but it is hoped that within the limited scope of the article enough has been said to point the way to the possibility of using, for the conservation of wild life and the greater enjoyment of it by the people, many similar sections of the State which may have failed to demonstrate any considerable value for other purposes.

# A PRELIMINARY REPORT ON THE TROUT STREAMS OF SOUTHWESTERN CATTARAUGUS CO., N. Y.

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## GENERAL DESCRIPTION AND PHYSICAL FEATURES OF THE REGION

**Location:** The tract of land which contains the streams of this survey comprises the extreme southwestern part of Cattaraugus County, principally the towns of South Valley, Randolph and Cold Spring. It is on the opposite side of the Allegheny River from the Allegany State Park, but like this park, it is separated from the river by the Allegany Indian Reservation which occupies the territory within (approximately) the half mile limit on both sides of the stream. The extreme southwestern part of the area reaches the Pennsylvania border. Randolph village can be roughly considered as being the northern limit and Steamburg the eastern. The territory is mainly in the Allegheny River drainage although a portion lies beyond the divide in the Chautauque Lake drainage.

**Topography:** This is a part of the old Alleghenian Plateau, but so greatly modified by the processes of erosion that instead of the former comparatively level area there now exists a more or less nearly parallel series of long narrow ridges alternating with deep narrow valleys extending in part from west to east but principally northwest to southeast. These ridges end rather abruptly where they meet the valley of the Allegheny River.

The elevations vary from a little more than 1200 feet to slightly over 2100 feet above mean sea level, the higher elevations on most of the ridges being around 2000 feet. There are thus no distinct peaks towering above the surrounding ridges.

The distance along the slope from the top of any principal ridge to the bottom of its adjacent stream valley, roughly considered, is about half a mile, and with a drop of 700 to 900 feet in this distance the slope is such that there naturally occurs a vary rapid runoff. This water action has been so violent in the past that the topography is now rather rugged. Yet when one considers the countless ages during which this action has been going on it is surprising that the effect is not even more pronounced. Of course these slopes are relatively short compared with those of some other hilly or mountainous regions, consequently the total amount of water on any one slope would be correspondingly less. This fact no doubt accounts for the comparative shallowness of the ravines leading down the slopes. The original forest cover, luxuriant as it is said to have been, was undoubtedly a great factor in checking the erosive action of the water in the past.



From the time that the first lumbering operations in this region began about half a century ago, and up to the present, it is quite likely that the topography has been modified to a greater degree than it had been in a much longer period previously. The area is not so denuded as it was in the more recent past, but even now the streams very quickly fill and overflow their channels with muddy water, after a heavy storm, and then subside at a surprisingly rapid rate. The clear cutting of hardwoods for chemical purposes has perhaps resulted in the most pronounced effect on the topography and this effect might have been much more severe except for the fact that hardwoods have been able to re-establish themselves relatively fast, a fact that can be largely attributed to the generous precipitation in this region during the growing season.

**Climatic Conditions:** The average annual precipitation in this section is much greater than in any other section of the State. The nearest weather bureau station at the present time is in the adjoining Allegany State Park, but this has been in operation for only a trifle more than two years. For records prior to that time I have consulted the data from the Jamestown Station, which is slightly to the west but which would not, in all probability, be expected to show any appreciable deviation. Professor H. R. Francis ('22, p. 61), in discussing the climatic conditions of the Allegany State Park, states that "the park region is reported to have an average of 60 inches [precipitation] per year." This figure is considerably higher than that given in recently published records for the Allegany State Park and Jamestown Stations.

In 1915 there was recorded a precipitation of 38.48 inches for the Allegany State Park, or about six inches more than for most other sections of the State. The first nine months of 1926 registered a precipitation of 32.79 inches at the same station. It is interesting to note that nearly half of this, or 14 inches, fell during August and September. This record is also about six inches higher than that for most of the other stations in the State.

The prevailing winds are from the west, and Professor Francis (l. c., p. 61) thinks that this fact partly accounts for the heavy precipitation: That when these warm winds, heavily laden with moisture from off the Great Lakes, meet the cooler air of the elevated plateau ridges, their moisture is condensed and precipitated.

The maximum and minimum temperatures for this region during the summer months are not much different from those of certain parts of the Adirondack region. Frequently they are somewhat less.

The writer has camped in both regions several summers and has always found it more difficult to keep warm at night in this part of the State than in the Adirondacks. In the Allegany State Park during the warmest weather (August) in 1922, several blankets were needed to keep one comfortable at night, and one member of our party complained that he slept cold every night despite the fact that he had something like seven army blankets wrapped about him. I must remark, however, that two or three comforters would probably have been more satisfactory, for army blankets are stiff and do not seem to keep the cold out so well.

### **HISTORY OF THE FOREST COVER AND ITS SIGNIFICANCE FOR THE TROUT STREAMS**

The original timber on this area, according to local informants, was a mixture of conifers and hardwoods. Of the first group, white pine was the most important commercially, although hemlock was said to be more abundant. Maple and beech were the most important hardwoods, but some oak, black and yellow birches, chestnut, white ash and other kinds were abundant in places.

The first lumbering operations began about 50 to 60 years ago and were concerned with the white pine. With the exhaustion of this resource some 15 years later, the hemlock was next to go. The removal of the pines probably had very little effect on the trout streams but the cutting of the hemlocks must have opened up the forests considerably.

Although the loss of the trout of the small streams as the result of the removal of the hemlock was rather appreciable, yet there was perhaps an even greater loss in fish life in the Allegheny River, produced by the toxicity of vat washings from tanning mills that utilized hemlock bark. These mills were situated at various places along the river, including Salamanca, and very likely utilized the hemlock bark from this tract. Hence the cutting of the hemlock had a two-fold effect on the streams. The polluting of the river either by tanning mills or other industrial plants, some may say, would not have any direct bearing on the streams in the tract under consideration, but I am quite convinced that it had. Had not such pollution occurred certain parts of this parent stream would now furnish excellent habitats for large brook trout. There are today numerous spring holes in the river in which some of the more resistant but inferior species of fish take refuge from the disastrous effects of the polluted water. Brook trout formerly used these

spring holes, and if the water at that time was as bountifully supplied with natural food as it is now, and there is no reason to think it was not, it is not surprising that the trout thrived and attained such large dimensions as have been reported. But here is where the tributary streams that occur in the Onoville tract played a part of importance for trout. It was these streams that nursed the progeny of the "big fellows" of the river and protected them from marauding enemies, including adult fish of their own kind. These streams were thus an important factor in nature's plan for the perpetuation of trout in the river; and a product (bark) of the hemlock trees, presumably from the same area was an important factor in upsetting this plan.

The best part of the remaining beech and maple forest was removed at a later date. After this removal it is said that a very dense stand of hardwoods in mixture with a relatively few conifers soon covered the area, as a result of vigorous natural reproduction. Then there developed a market for hardwood at the wood distillation plants, and clear cutting accordingly resulted over many areas. Many of these clear cut areas were never allowed to re-establish a forest cover, but were prepared for agricultural crops or pastureland.

Following the war the market for chemical wood suffered a severe slump, and little if any cutting for this purpose has since taken place on the tract, thus giving the areas not in pasture or under cultivation an opportunity to support a stand of hardwoods.

It is rather unfortunate that the conifers have become such a negligible factor in this mixture and I am firmly convinced that this one thing will be the greatest handicap in any efforts which may be made now toward restoring the streams to their former conditions. The conifers, retaining their foliage the year around, produce a screen which protects the duff and soil from the drying effects of the sun and the wind. Decomposition is thus much slower in a coniferous forest and the duff becomes much deeper. In addition, there naturally occurs a difference in flora; mosses, lichens, ferns and the like which are quite resistant to shade and which aid materially in protecting the soil from evaporation and erosion. As a result, under such conditions the water in the streams would have a much lower temperature, another essential factor for the existence of trout.

Very little lumbering is taking place on the tract now. A portable mill on the South Branch of Sawmill Run was cutting principally railroad ties, during my work there. Another on Hotchkiss Run was cutting lumber from oak, maple, cherry, ash, etc. There was still another mill at the headwaters of Bone Run and one at

the extreme upper limit of Phillips Brook. These individual lumbering operations, with the exception of the one on the South Branch of Sawmill Run, are not in themselves extensive enough to do any appreciable damage to the streams.

## THE STATUS OF FARMING AND ITS INFLUENCE ON THE STREAMS

Most of the valley bottoms have been settled by people who have attempted to make a living by farming. I say attempted advisedly because from all appearances it was not a complete success. Perhaps it was profitable when combined with certain phases of the former lumber industry, so long as the soil was fertile; this is quite likely true for the buildings indicate that prosperity once reigned. The fact remains, however, that farmsteads now found in all the valleys, with but a few exceptions, are in a rundown and unprosperous looking condition. The farms are slipping, as it were, and unless conditions are changed by man nature will step in and eventually transform the open lands into forest.

The lowlands now are cultivated for hay, corn, potatoes, oats and buckwheat, while the hillsides and frequently the land adjacent to the streams are pastured. It is, perhaps, needless to say that this cultivating and pasturing of the valleys has been a major factor in the failure of the streams to support brook trout. Figures 48 and 60 clearly show what takes place when pasturing is allowed along the streams. The stream bed becomes wider, the undergrowth is destroyed and the water consequently becomes warmer. Frequently the headwaters of the streams are utilized in this manner, but more generally the lower courses. The farms at the lower ends of the valleys are larger, more productive and nearer to market; hence these will undoubtedly survive for some time.

Inasmuch as the land in the upper valleys has proven to be unprofitable for agricultural purposes it is gratifying and encouraging to know that it is still suitable for forestry purposes. Nature has assisted wonderfully in the fulfillment of this purpose, and with the lands reverting to forests again certain streams are already "coming back" in that they are gradually developing better conditions for the support of trout. Notable examples of this kind are Phillips Brook and the North Branch of Bone Run.



## DESCRIPTION OF THE STREAMS AND THEIR FISH POPULATION

The principal stream systems of the area and the ones which will be discussed in this report are, (1) State Line Brook; (2) Sawmill Run and its tributaries, the North and South Branches and Brown's Run; (3) Bone Run and its tributaries, the North Branch and Phillips Brooks; (4) Pierce Run; (5) Hotchkiss Run. The headwaters of certain other streams in the Chautauqua Lake drainage were visited but not studied.

It was not a very difficult task to reach these streams since in nearly every case they were accessible by roads that pass through the valleys and within a relatively short distance from the stream bed. Some of these roads were rough yet I managed to traverse them in an automobile.\* For my work this matter of accessibility was an important thing, but from the viewpoint of the good of the trout it would have a different significance, for local fishermen as well as those from distant parts can reach almost any point on these streams in a relatively short time. There is, however, no cause for concern at the present time since the fishing is not good enough to attract many anglers. When planting is being done in the streams, the roads are, however, quite indispensable.

**State Line Run.** This stream, as the name implies, flows very near the border line between New York and Pennsylvania. The main channel is in New York, but I believe that some of the tributary streams have their sources in Pennsylvania. The main stream begins at an elevation of about 1500 feet and flowing nearly due east, mostly on the south side of the valley, enters the river less than three miles away. The extreme upper end of the Run flows through open fields and pastures, but about one-quarter mile downstream, where I first began collecting, it enters an old field grown up with golden-rod, joe-pye weed and boneset, together with a considerable amount of sedge grass. The southern slope comes nearly down to the stream and supports a second growth stand of blue beech, yellow birch, maple, elm and low willows, so that the stream was partially shaded.

The channel here was about 12 feet wide, but the stream averaged about one-third that width. The bottom was composed of loose

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\*Footnote: I am greatly indebted to Mr. Leonard Swan of Salamanca who very generously loaned me the use of his car for the work at the distant points of the tract.

rocks and small boulders mixed with some gravel. Except for a relatively few pools the water was shallow, barely over six inches deep.

The temperature of the water (72°F) was too high for brook trout but quite ideal for the following fishes which were collected: horn dace (*Semotilus atromaculatus*), black-nose dace (*Rhinichthys atronasus*), red-side shiner (*Clinostomus elongatus*) and fantail darter (*Catnotus flabellaris*).

Some fifty rods downstream the Run entered a closely cropped pasture and had no protecting trees of any sort. The stream here widened out, and there were two large pools and a smaller one. The largest pool was 10-12 feet wide, over three feet deep in places and with a soft miry bottom, somewhat in the nature of a slough hole.

Quantities of red-side shiners (*Clinostomus elongatus*), black-nose dace (*Rhinichthys atronasus*), horn dace (*Semotilus atromaculatus*), common suckers (*Catostomus commersonii*), hog suckers (*Hypentelium nigricans*) and crayfish were found here, but no brook trout. A small boy fishing here said that he had caught, on a previous date, a six-inch trout.

Large piles of gravel and boulders with other stream channels about the pasture, indicated that a surprisingly great amount of water passes through here during the spring freshets.

From the pasture the stream meandered through a partially wooded area for nearly half a mile. The south shore with the adjacent slope was quite wooded while the opposite side was only partially so. Large hemlocks bordered the stream and overhung it in many places. Further protection was given the stream from sunlight by large clumps of sedge grass, which all but concealed it in places. A family of muskrats living here had been eating the tender parts of the sedge.

Deep pools under shelving rocks or partially undermined trees were rather frequent along the stream at this point and would be excellent places for harboring trout. I was rather thorough in my seining but captured no trout at all. I saw one about five inches long partly concealed under a small rock in a shallow gravelly riffle, but did not succeed in capturing it.

The temperature of the water in the stream was 71°F: obviously too warm for trout but excellent for dace, darters, suckers, etc., which were relatively common.

From this section there was an open stretch of the stream for about another half mile which was quite distinctive in that it flowed through meadowland, had a rather uniform depth of water and sup-

ported schools of fry. The only woody plants were a few low willows.

Nearly all the essential requirements of a brook trout stream were lacking in this section. There was plenty of food, but the temperature was far too high and this alone, not to mention the shallow water, absence of pools, and lack of cover, would render it unfit for trout life. Other fish were, however, common, and included such species as common shiner (*Notropis cornutus*), stone roller (*Campostoma anomalum*), horn dace (*Scmotilus atromaculatus*), fantail darter (*Catonotus flabellaris*), red-side shiner (*Clinostomus clongatus*), two kinds of suckers (*Catostomus commersonii* and *Hypentelium nigricans*), and sculpin (*Cottus bairdii*). The red-side shiner was the most abundant. Fry of horn dace and blacknose dace were gregarious here, especially in the very shallow places over sandy bottom.

The remaining part of the stream (three-quarters of a mile) lies in the Indian Reservation and in what is known as the "Indian Woods." Second growth beech, birch, maple, with some hemlock, blue beech, butternut, etc., occur on both sides of the stream but do not form a complete canopy so that the sun has access to the water. The Indians have done a certain amount of selective cutting for fuel, and here the golden-rod and other weeds have come in abundantly.

In some respects conditions for trout were somewhat better in this part of the stream. There were several deep pools which would be excellent for trout, and from the deeper of these I procured several specimens of trout perch (*Percopsis omisco-maycus*). In one place the water covered an area 4 rods long and one rod wide to a depth of  $1\frac{1}{2}$  to 2 feet, and even deeper at one hole. Several hog suckers (*Hypentelium nigricans*) 8-10 inches long were resting in the shallow part of this pool, but as I approached hurriedly they retreated to the deeper parts and under the shelving rocks. The stream here broadened out through the woods and in places occupied a bed 40 to 50 feet wide.

The temperature of the water entering this section was 74°F, but this became reduced somewhat by a small stream coming in from the south, with water at 67°. Judging from the size of the bed of this tributary stream it must furnish an abundance of water during the spring months.

I was unable to secure any trout from this section, with a net, but since the most likely places for them were cluttered with brush or other obstructions it is quite likely that some, though perhaps not many, may have been present. The best pools were found under

and about undermined trees where the roots prevented access with the net.

On the riffles I secured long-nose dace (*Rhinichthys cataractae*) and the beautiful little rainbow darter (*Poecilichthys coeruleus*). Johnny darters (*Boleosoma nigrum*) and straw-colored minnows (*Notropis deliciosus*) were also found here, in addition to the usual species occurring elsewhere in the stream.

State Line Run is far from being a satisfactory stream for brook trout at the present time. Certain sections show that conditions have been proper for trout in the past, but the subsequent settlement of the valley no doubt spelt ruin for them. The stream appears to be at its worst at present for the effects of the abandonment of farmsteads is of only recent date and the forests have not had sufficient time to reclaim the open areas, which are rather extensive especially on the northern slopes. Now, with the entire valley abandoned, except the upper end, the future so far as trout are concerned appears rather encouraging.

It would seem useless to plant brook trout in the stream at the present time. Fry or fingerlings would doubtless meet with severe competition for the available food supply. The majority of the other species of fishes now inhabiting this stream feed upon practically the same organisms as do the fry or fingerlings of the brook trout. Larger brook trout would, however, prey on these minnows, darters, suckers, etc., to some extent. They would also perhaps take advantage of the abundance of crayfish as well as caddisfly larvae, stonefly and damsel fly nymphs and other common insects that are rather abundant here and which are not so readily taken by smaller fish.

When the temperature of this stream drops below the maximum (68°F) for brook trout, as it is likely to do when once the proper forest cover is restored, a large portion of the other fishes will probably not be found here. They will seek warmer waters. The sculpins, a few horn dace and possibly a few red-side shiners and black-nose dace are practically the only species that are likely to remain. I have found this to be true in other streams in this tract, in the Allegany State Park, and elsewhere.

With a few exceptions there are already enough pools in the stream for the trout, provided other conditions were proper. I believe, however, that a few sticks of dynamite used at well chosen points during extreme low water stages, for the creation of deep pools, would greatly add to the resources already naturally present for the welfare of trout. Certainly the cost would not exceed the





Fig. 39. Typical scene on Sawmill Run, a short distance above the river. Note the shallow pools and intervening riffles. July 7, 1926.



Fig. 40. Upper end of the North Branch of Sawmill Run. The pool in the foreground was produced by cattle wading across. July 16, 1926.



Fig. 41. Main channel of Sawmill Run a few rods below the forks, in pastured area. Low willows on the left protect the stream somewhat. July 7, 1926.

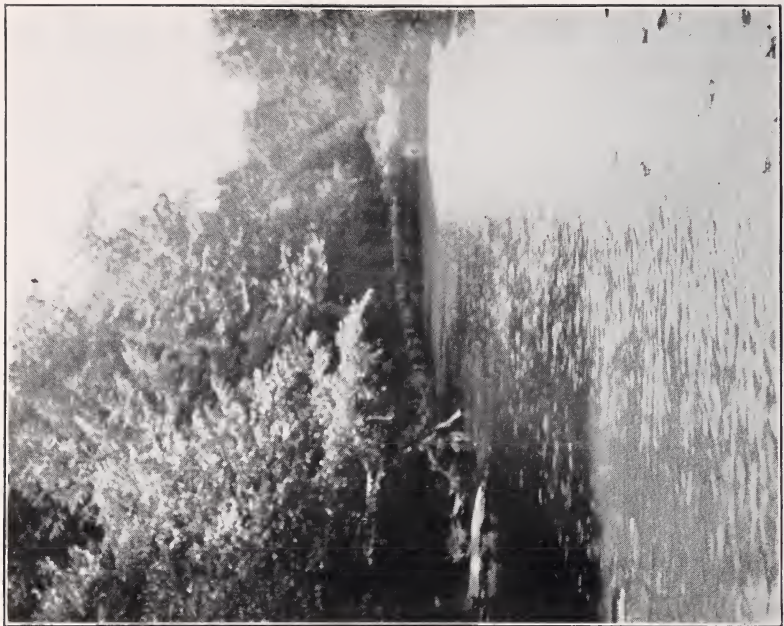


Fig. 42. Long shallow pool and riffles in Sawmill Run near mouth of Brown's Run. Good sucker habitat. July 7, 1926.

value of a few cans of planted fish which might otherwise fail to survive.

Suitable breeding places for trout were rather rare. In fact, I do not recall a single area which I would expect trout to utilize for this purpose.

**Sawmill Run and Tributaries.** This is the largest stream on the tract and has probably been the most important one in the past. Besides the main channel there are three tributary streams of importance. The main stream is really made up by two of these, i.e., North Branch Sawmill Run and South Branch Sawmill Run. Brown's Run enters Sawmill Run about three-fourths of a mile above its mouth.

*North Branch.* This branch has its source near the Chautauqua-Cattaraugus County line at an elevation of about 1900 feet. It flows through a rather narrow valley to join the main stream some three miles below.

The upper half of this branch has very likely in the past produced a satisfactory yield of brook trout, judging from present conditions. It looks as if some of the last clear cutting for chemical wood took place in this section, for the new growth was now only 8-10 feet high. Extensive areas of this type coupled with still more extensive areas of open meadows and pastures have made a uniform supply of water to the stream impossible. The water was very low during my visit in the middle of July, nevertheless I was surprised to find its temperature so low as recorded, for most of the stream traversed pastured areas and had only partial protection from the sun by scattered trees and small groves (see Fig. 40). I rather expected to find the temperature above the maximum for trout, but instead I found it varied from 66° to 68°F. A farmer (Mr. Murphy) living here told me that the water had reached its lowest level and would not become warmer, because several spring feeders occurred along this section. His statement concerning springs was unquestionably correct, otherwise the water would have been warmer and the temperature would have gradually increased downstream instead of fluctuating to the extent actually recorded. I found no trout in this section but I believe the species to be present in small numbers. It was said that "Austrians" living near the stream have depleted the trout by fishing out of season and by using illegal devices. Personally I doubt if many trout attain legal size here. Horn dace, red-side shiners, black-nose dace, sculpins, stone rollers, etc., were collected, the first two being the most abundant.



The lower half of this Branch was separated from the upper part by a section of dry stream bed. On my first visit, July 6, I thought that the stream was dry above this point, but I found later that it seeped through beneath the upper layers of rock and gravel (see Fig. 43).

The water immediately below this dry stream bed was very shallow and in places it had almost wholly disappeared. The stream was, however, surrounded with a good stand of second growth hardwoods, and white pine. Fish such as red-side shiners, horn dace, and black-nose dace, were found here in relatively small numbers.

About 12 rods below, the stream crossed the highway and came very close to the rather steep slope on the south side of the valley. The stream at this point widened out somewhat and occupied about 6-8 feet of the channel which had a maximum width of 25 feet. The bottom was very rocky, yet there were only 4 or 5 small pools in a distance of one-third of a mile through a wooded section. The water along this part of its course was somewhat cooler (60° F) than in the upper waters, but I found no trout. Common suckers, red-side shiners, pearly minnow (*Margariscus margarita*), sculpins, long-nose dace (*Rhinichthys cataractae*) and horn dace were taken in the net.

After leaving the wooded section the stream flows through an old pasture for about three-fifths of a mile (see Fig. 44). A few low willows, sedge grass, timothy, alsike clover, etc., furnished the only protective cover for the stream and it was interesting to find that the temperature of the water had risen 10 degrees, or up to 70° F while flowing this short distance. This can be accounted for by the fact that, in addition to being exposed, the stream here was very shallow, rather sluggish (being in a low flat area) and contained numerous projecting rocks, all of which aid the sun in its warming effect.

Red-side shiners were very abundant here, with black-nose dace and horn dace taking second place. No brook trout were found.

The next section of the stream takes in the remainder of this North Branch and includes that part of the stream between the forks and the Highway bridge above, a distance of more than one-half mile. The upper part of this was wooded with saplings of yellow birch and maple, with a few hemlocks and larger hardwoods; the lower part was through a pasture with only a few bushes and an occasional tree (maple or elm) for protection. The trees even in the wooded part did not shade the stream properly, so that the water was exposed to the sun and its temperature reached 76° F at the forks. The stream bottom was very rocky in this section and there were only a few deep





Fig. 43. Section of North Branch Sawmill Run, above second bridge. Stream partly underground for some distance. July 7, 1926.



Fig. 44. Grassy abandoned pasture along North Branch of Sawmill Run. July 7, 1926.

pools. In one of the deep pools I took hog suckers (*Hypentelium nigricans*) and stone rollers (*Campostoma anomalum*). Darters were taken on the riffles. Red-side shiners were most abundant, with black-nose dace and horn dace next in order. No trout were found although everything except temperature seemed favorable for them. There were a few excellent pools.

This branch is probably capable of supporting a few brook trout at its upper end, but even here I would not encourage planting until a better forest cover is established. The territory adjacent to the stream being unwooded and largely pastured provides very little protection and probably furnishes but few terrestrial insects for food. Although the stream is spring fed, a greater volume of water would be supplied at a more uniform rate if the forests were better established. The present forested areas, as has been stated previously, are just recovering from the severe clear cutting of a few years past.

Much of the land in this valley is unproductive for agricultural purposes, and most of the farms are already abandoned. Those at the very headwaters will undoubtedly exist longer than the others. Some of the dwellings below the headwaters have been abandoned within the last few years and are still in good condition. In my opinion this branch will show a vast improvement within a few years, due to natural reproduction, unless some unforeseen project develops.

*South Branch.* This branch starts in Chautauqua County at an elevation of nearly 2000 feet and not over half a mile from the source of the North Branch. The branches are, however, more than two miles apart farther down. There was very little water in the stream on July 16, near the county line, but it was partly of spring origin, and cold (56°F). The stream was well protected from the sun by a good stand of second growth hardwoods and some hemlock. The crowns of the trees did not always meet over the stream as the stream bed averaged 10 or more feet in width. The stream bed was composed of large and small angular rocks with gravel and sand deposits in places. Although there were only a few small pools at the upper end there were many more and larger ones farther downstream.

Horn dace, black-nose dace and sculpins were taken in the upper waters, but these species were not numerous. Several sculpins were noticed on the bottom, but could not be captured as they hid under the rocks. In one of the larger pools about one mile east of the county line I caught a 5-inch brook trout in the net, the only one observed in the entire length of this branch.

The stream was considerably larger where the trout was taken;

there were also many large boulders and the pools were deeper. The forest here has been opened up during the past two years by the cutting of hemlock for a mill about one mile downstream from this point. This has allowed the sun to increase the temperature of the water to  $59^{\circ}$ , but a small stream coming in from the north a few rods below the trout pool, with water at  $54^{\circ}$ , lowered the temperature slightly. The water, even in the pool where I found the trout, was rather turbid and there was other evidence in the form of cuttings which indicated that muskrats were living here. Their work was more noticeable nearer the sawmill mentioned above. Conditions were more favorable there for these animals, since a considerable area of trees along the stream had been removed and food in the form of sedge grass had come in abundantly. Then too, the dam at the mill had backed up the water for several rods, so as to form suitable pond conditions for muskrats. This dam of course affects the stream somewhat as a trout water but in itself will not do any particular harm now since there are no trout present; but it would certainly prevent fish from ascending this stream.

This section below the sawmill was studied on July 7 and 8 (more than a week before the upper section). Although the upper part of this section was wooded with second growth birch, maple, elms, blue beech and the like, considerable sunlight gained access to the stream because the tree crowns could not span the 25 feet or more of the stream bed. The stream itself occupied barely one-third of the channel and was not over a foot in depth on the average, except in the pools.

Low willows were common along the stream toward the lower end, but the last quarter mile or so was through abandoned meadowland. Large piles of stones, gravel and sand and old channels at this end indicated that a relative'y great volume of water passes through here during the spring freshets.

Conditions for brook trout in this section were not promising in the existing state. While the temperature range of  $65^{\circ}$ – $70^{\circ}$  did not equal or greatly exceed the maximum ( $68^{\circ}$ ) for trout, there was strong likelihood of its becoming much higher by mid-August. The volume of water would probably become much reduced too, so that the trout, if they occurred, would be compelled to concentrate in the relatively small number of deep pools. The quantities of other fish such as horn dace, black-nose dace, red-side shiners, stone rollers, suckers, darters, etc., would be obliged to seek the same pools (or retreat to the main stream) and thus competition for the available food supply would be very keen.

With the exception of the lumbering activity, this South Branch of Sawmill Run was practically abandoned last summer. Some of the houses formerly used by farmers were being occupied by the lumbering crew. It is unfortunate for the stream that this lumbering is taking place, for the forests were rapidly encroaching on the abandoned fields and it would have been but a matter of a relatively short time before the forest cover would have been sufficiently established to influence the runoff and water supply. The effect of the lumbering, even if it ceases with this year's cutting, will be felt for several years to come.

The water in the headwaters was of spring origin and somewhat below the maximum temperature for brook trout. The temperature of the water in the other section including the deep pools was, however, rather excessive for trout, due to the open character of the forest cover. For this reason the trout have been supplanted by quantities of dace, minnows, chubs, etc. This stream is less capable of supporting trout now than it was three years ago.

*Main Channel.* The main channel of Sawmill Run is almost three miles long. It flows for the most part through pastureland and is unwooded except in a few places where there are scattered trees or where the wooded south slope comes down to the stream.

Studies were made July 7 and 8 on the first half mile below the North and South Branches, the lower limit being the first culvert at the main highway. The entire section of the stream traversed a rather flat area so that it was sluggish and widespread in many places. The channel at the upper end would average perhaps 25 feet in width while the stream occupied about 10 feet of this in places. The bottom was covered with quantities of stones and gravel.

A few rods farther downstream a very dense growth of low willows bordered and partially protected one side of the stream (see Fig. 41). These willows forced the stream into a narrower channel and produced quicker water, of a rather constant depth of 6-12 inches. Except for a few projecting rocks the even bottom was composed of gravel and sand.

Conditions below the willow bordered area were similar to those above it, except that the channel was much wider and that the stream covered a greater area. Huge piles of stone and gravel deposits on the shores and in old channels outlined the relatively immense area occupied by the stream in the spring floods and indicated how effective such a rapid runoff is in its eroding action. It is quite reasonable to believe that conditions like these did not prevail before the advent of the lumberman.



The temperature ranged well above 70°F, and at the culvert (lower end of section) registered 81° at 4 P. M., July 8. This was much too warm for brook trout even if other conditions were suitable, which they were not. The absence of deep pools and the presence of a superabundance of competing species of fish would offer too great a handicap for brook trout.

The next section, which begins at the culvert and extends down to Brown's Run, a distance of approximately one mile, contained more water, had several deep holes and was otherwise much better suited to trout, but the temperature here was still too high for their existence. Under the culvert and extending several yards below was an expanse of water 15-20 feet wide and 2-3 feet deep (deeper in one place) which contained several large common suckers, horn dace, an abundance of the other dace, and minnows. Here I saw one brook trout that was perhaps 8 inches long. It disappeared into the deepest part where I could not reach it with my net. Although the water was warm here (81°F) I suspect that the temperature was considerably lower at the bottom of the deep pool. Some of the suckers were at least a foot long.

There were two other rather large deep pools and some smaller ones in this section. The intervening parts of the stream consisted of riffles or shallow water over a bed of large and small stones. In some places the channel was at least 25 feet wide and indicated that during high water it was double this width. In such places frequently the water was so distributed that it did not exceed a depth of 6 inches. There were also large piles of drift material along this section which had been deposited during high water periods.

Of the fishes occurring in this section of the stream, long-nose dace, rainbow darters (*Poecilichthys coeruleus*), johnny darter (*Boleosoma nigrum*) and straw-colored minnows were taken on the riffles, while trout perch (*Percopsis omisco-maycus*), common shiners, horn dace, black-nose dace, stone rollers, common suckers, hog suckers, sculpins and red-side shiners were found in the deeper waters. Many of the latter were breeding fish. Black-nose dace were apparently the most abundant.

The lower part of this section was partly wooded, especially on the south shore, and in one place several hemlocks hung well over the stream. The temperature was quite uniformly 76° F.

The last section of Sawmill Run (from Brown's Run to the river), which was about three-quarters of a mile in length, was wholly within the Indian Reservation. The stream here was not much different from what it was in the last section, being only somewhat

wider and a trifle colder in places (minimum of 70°). The lower temperature can be accounted for by the fact that the wooded south slope ends abruptly at the stream so that rivulets containing cold spring water seep into it.

Figure 39 shows a typical view of the stream although two or three shallow expanses of water, like the one shown in figure 42, occur. There were three or four pools at the bases of large trees or under shelving banks in this section, which were over three feet deep. These were inhabited by both kinds of suckers and the other smaller fishes. The cut-lip minnow (*Exoglossum maxillingua*) and the trout perch (*Percopsis omisco-maycus*) were found in one of these holes.

On the riffles and in other shallow places black-side darter (*Hadropterus aspro*), green-side darter (*Etheostoma bleunioides*), johnny darter (*Boleosoma nigrum*), rainbow darter (*Poeciliichthys coeruleus*), fantail darter (*Catnotus flabellaris*) besides black-nose dace, red-side shiners, common shiner, *Notropis volucellus volucellus*, *Notropis dorsalis*, blunt-nose minnow (*Pimephales notatus*), sculpins, and stone rollers were taken. Schools of fry were noted in the side pools. Horn dace were found spawning on their nests in several places. But no trout were found here.

The main channel of Sawmill Run is less capable of supporting brook trout than the tributary streams. It is too exposed, too warm, and in its present condition contains too many competing species. The greater portion of the valley is inhabited and the areas along the streams are mostly pastured, hence conditions there are not likely to improve to any important extent. There are, however, several excellent deep pools and these would be available for trout during the spring and autumn when the water is colder. But the torrents of water that frequently sweep down this valley during these seasons may render conditions quite unfavorable. If this stream should ever become improved sufficiently to meet the requirements of brook trout, its tributaries would serve very well as nursery streams.

*Brown's Run.* This is a small tributary of Sawmill Run which enters from the south at a point just outside the Indian Reservation. It is scarcely two miles long and so small that it has little significance as a brook trout stream. I studied this stream on July 9, beginning at its extreme upper end. Here it lies in a very narrow valley that supports a good stand of second growth birch, beech, maple and blue beech, with some ash and hemlock and an occasional chestnut or black cherry. Figures 45 and 46 show very well the type of forest

that occurs along the stream. Unfortunately the stream is not abundantly supplied with water, for a considerable portion of the upper end is dry or nearly so. A few shallow pools occur in depressions under old logs or stumps (see Fig. 45) but there is only a trickle of water in the intervening spaces. Deposits of sand, gravel and small flat angular rocks make up the stream bed and these support a thin layer of muddy silt left by the receding water. Figure 46 shows the nature of the stream bed.

The temperature of the water in the small pools was 61° at 10 A. M. This was cold enough for brook trout, but I found merely a few horn dace and sculpins.

Some 10 or 15 rods below the point where the above photographs were taken the water was of sufficient volume to form a stream, flowing over a bottom largely of gravel and sand. Four pools beneath partly undermined trees occurred in a few rods of this section. These were 3 to 4 feet deep and would have made excellent pools for trout had there been more water in the intervening stretches. The temperature (63° F) was well below the maximum for brook trout and was unusually cold for such a small volume of water. The spring feeders must be rather near.

At a point about 1¼ miles above its mouth this stream began to assume a more unfavorable aspect. Fewer trees with more briars, golden-rod, small willows, etc., occurred along the margin. The small volume of water thus became exposed to the sun and its temperature consequently rose a few degrees and reached the maximum that brook trout can comfortably stand. Horn dace and sculpins still occurred here, the former in greater numbers than above. Black-nose dace also began to make their appearance in small numbers, but like the others were limited mostly to pools.

A few rods farther downstream Brown's Run flowed through a pasture for perhaps six rods. There was very little water here and only two small pools.

The remaining part of the stream was in open country or pastured areas. Sedges, small willows, shrubs, etc., concealed the stream in places outside of the pastured areas, but the sun was able to bring the temperature of the water up to 78° F. The pastures were cropped rather close and this, of course, further increased the effectiveness of the sun's rays.

Just below the wooded area I found red-side shiners (*Clinostomus elongatus*), and horn dace at this point became more numerous. Farther down, fantail darters were taken on the gravel areas, where the stream did not exceed two feet in width in many instances, and





Fig. 45. Upper limit of water in Brown's Run, looking upstream. Some water in the pools under the old logs. July 9, 1926.



Fig. 46. The dry bed of Brown's Run, looking downstream a few rods below the scene in Fig. 45. July 9, 1926.



the pools were neither plentiful nor large. Near the lower end large piles of stones and boulders lay piled along shore, having apparently been cleaned out of the stream bed by the farmers, thus leaving it even and gravelly. Here were found a good many young horn dace, common suckers, and common shiners; also mature stone rollers, red-side shiners and darters. The last few rods of the stream were in a pasture, and several spring rivulets entered it here.

Brown's Run at its present stage is too small and contains insufficient water of the proper temperature for brook trout. A considerable section of its upper course was nearly dry at the time of my visit in early July. Although the valley did not seem to be very productive, yet much of the lower half was still occupied. For this reason it will perhaps be several years before any marked improvement in trout conditions occur; but with the proper forest cover I feel sure that this stream would be made suitable.

**Bone Run and Its Tributaries.** In addition to the main channel, Bone Run has two tributaries: North Branch Bone Run and Phillips Brook. These tributaries are far more important as brook trout producers than is the main stream. The entire system suffers during dry seasons for the want of sufficient water, but the main stream is said to become entirely dry. Numerous small springs feed the tributaries.

*Main Channel.* The main channel begins within a half mile of the Chautauqua-Cattaraugus County line, but the first mile of it was so small and contained so little water that I did not study it in detail. I might say that the stream at this upper end was nearly concealed everywhere by a dense growth of willows and by a tangle of golden-rod, clematis, jewelweed, joe-pye weed, boneset, and a few trees such as blue beech, elm and birch (see Fig. 47). The place where I began collecting was so densely overgrown with willows that it was difficult to force a way through them. The roots of these willows, furthermore, extended into the water and thus created another hindrance. The stream here had a channel about four feet in width, but scarcely half of this was occupied by the water. Recent rains had raised the level somewhat but it was not over six inches deep now (July 12). The temperature was 67° F.

The bottom was mostly of a muddy character covered with a layer of mossy vegetation that had dried and partly decayed during the low water of the previous week. A few flat stones were mixed with the mud and in addition there were a few gravel areas.

The valley is very narrow at this place and is only partly wooded.

Its south side contained a sapling growth of hardwoods and a few scattered pines and hemlock, while the north side consisted principally of abandoned fields or meadows.

Several rods below where I began collecting, the stream flowed through an open meadow where it had cut a channel through a bank four feet high. The bottom was level and consisted of a hard clay formation covered with a layer of small thin flat stones.

The region about the mouth of the North Branch of Bone Run was forested with saplings, on the south side of the stream, but on the north side was a bordering dense growth of willows. Here the stream became larger and had a few deep holes, but the water was very turbid, probably caused by muskrats for I noticed evidence of their work.

No trout were found in this section of Bone Run, above the mouth of the North Branch. Other fish were scarce in the upper waters and were limited to horn dace, black-nose dace, common shiners and fantail darters. These were mostly from one open pool in a recently made clearing.

The pools farther down contained in addition to the above species, common suckers, stone rollers, red-side shiners, sculpins, blunt-nose minnows, johnny darters, and Gilbert minnows (*notropis dorsalis*). All were relatively common. Green frogs and their tadpoles were relatively common in the entire section and a few salamanders were found. Crawfish were common.

A sawmill about one mile above the mouth of the North Branch appeared to furnish the only activity in this section of Bone Run. Possibly the two or three farm houses at the extreme upper end were in use, but it seemed doubtful.

Below the North Branch, the main stream broadened out considerably. In many cases the stream had cut through a bank four feet or more in height and some 12 feet or more in width. The water, however, was not deep except in the pools, which were only occasional here. It probably would not average over 12 inches—perhaps considerably less—after the stream should have reached normal level following the recent rains.

It is a good mile from the mouth of the North Branch of Bone Run to the mouth of Phillips Brook. Except for a short distance near the first of these tributaries, the stream flowed through a meadowland; consequently the only bordering trees were low willows. These were very dense in places but insufficient to prevent the sun from warming the water to a temperature of 73° F. Needless to

say, there were no trout in this section, but several species of other fish were very abundant. These were, in order of abundance, horn dace, red-side shiner, black-nose dace, straw-colored minnow, fantail and johnny darters, common suckers, stone rollers, common shiners, blunt-nose minnow, hog sucker, and rainbow darters. A number of fry, mostly horn dace, black-nose dace and common suckers were noted, and conditions seemed to be quite proper here for their spawning activities.

Just below the mouth of Phillips Brook the stream flowed through an unused pasture, and here were several channels or remnants of channels (see Fig. 48). In some expansions in the stream where the bottom became very silty, quantities of small fish occurred.

About a quarter of a mile downstream Bone Run flowed through an area bordered by an abandoned field on the south side and by a meadow on the north side. Dense growths of willow, with boneset, joe-pye weed, jewelweed, virgin's bower and golden-rod mingled with clumps of sedge grass, made it almost impossible to reach the stream and made seining very difficult. The adjoining slopes were mostly pastured, in some cases to near the summit (as noted in Fig. 48).

Woodchucks occurred along this stream, and probably muskrats to a limited extent.

The remaining part of the stream flowed through tilled fields or pastureland, and aside from the fact that there was a somewhat larger stream bed it was much the same as in the last section.

No trout were found and the other fish consisted of the same species as in the previous section, but apparently in greater numbers. Black-nose dace, horn dace and red-side shiners were most abundant. Both kinds of suckers (hog and common) were found in the deeper pools or expansions of the stream. Darters and long-nose dace were taken on the riffles. Schools of fry were common in the lower waters especially on the gravel areas.

The temperature reached a maximum of near 80° F in the lower limits.

The main channel of Bone Run is not now in the proper condition to support brook trout. The temperature even in early July was above the maximum for this species, and would become much higher before the end of August. In greater part, the channel was bordered by cultivated fields or pastures so that but little protection from the sun existed. A portion of the upper section somewhat approached proper conditions for trout, but this was too limited in extent. Except for the sawmill crew at the upper end, there was here no

human activity, unless possibly there is some farming at the extreme upper end. At the lower end, on the other hand, there were but few unoccupied farmsteads. It will probably be several years before much of the valley will be allowed to revert to forest.

The fact that this stream is said virtually to dry up during certain seasons is sufficient reason to discourage the planting of trout. As mentioned elsewhere in this report, some of the tributaries are much better suited for this purpose.

*North Branch Bone Run.* This tributary of Bone Run is one of the best streams in the Onoville section for brook trout at the present time. It lies in a very narrow valley that is not particularly well adapted to agriculture, so that the cut over lands have been allowed to revert to forests. There are only two houses along its entire course, one of them abandoned. Some of the lowland along its lower course is being used for agricultural crops, while some that has been recently cultivated is now lying idle.

The stream forks at a point about three miles above its mouth. The branch leading from the north was small and disappeared within a short distance from the main stream. It is quite open in character, so that black-nose dace and horn dace are found, but evidently no trout. I suspect that this section is spring fed for the temperature was 52° F on July 15.

The other branch was more than a mile long, but there was not enough water beyond the mile limit to warrant further investigation. There was no road along this particular part of Bone Run. The locality has never been settled, and the second growth reproduction has been allowed to develop undisturbed. A good stand of birch, maple, ironwood, blue beech, white ash, elm, cherry, etc. (as shown in figure 50), occurs along the stream. In places these trees are, for some reason, much larger than in others.

The Run averaged three or four feet in width but was shallow except for a few pools. The bottom consisted of loose, flat, angular stones intermingled with gravel and sand (as shown in figure 49). Frequently areas of gravel and sand were noted.

The low temperature (52° F) of the water and the supersaturated condition of the ground at various places seemed to indicate that this Run is fed by several small springs in its upper course. Earlier in the season an abundance of water is evidently supplied by several tributary streams from adjacent slopes, but these were now all dry, two of the larger ones apparently having but recently become so.

Brook trout had evidently been planted in this section the present



year (1926), for I found fingerlings in almost every little pool, even at the very headwaters. I should say that the stream appeared stocked to its full capacity at the time of my visit, and if the water had fallen much lower even these might have found conditions rather unfavorable for existence. A few larger brook trout were found, the largest one taken in the net being five and one-half inches long. Trails and tracks of men along the stream indicated that it had been fished rather recently, and I therefore had reason to believe that larger fish might actually be found here, otherwise undersized or illegal trout make up the catch. Certainly fish of legal size appeared to be scarce if present at all. Possibly they had been fished out after the water had reached this low level. Such a thing might easily have occurred for it does not require much skill to take brook trout with a worm bait, especially during periods of low water.

Some of the little pools (as shown in figure 49) contained as many as a dozen trout fingerlings, but this was not a common occurrence. In some cases fingerlings were taken on the riffles.

Other fishes were very scarce and represented but a few species, chiefly sculpins and horn dace.

The remaining part of this North Branch of Bone Run was studied on July 12. The first mile was well suited for brook trout, in several places. Although not heavily wooded, there was a stand of sufficient density to conceal effectively the stream which was very close to the western slope of the valley. Sapling blue beech, *Crataegus* (buck thorn), wild plum, maple, elm and many low willows made up the principal trees. Golden-rod, joe-pye weed, briars, virgin's bower and bee balm were common.

The stream gradually became somewhat larger and contained more water. In general, riffles alternated with deep pools. Some of the pools were three feet or more in depth. Frequently a rank growth of sedge grass hung over these pools furnishing excellent cover for the trout and shading the water from the sun. Many other pools occurred around partially undermined trees, thus furnishing additional hiding places for the fish. The water was quite turbid and I believe this was due to muskrats, evidence of their work having been noticed at several points. The temperature was somewhat higher (58° F) in this section than it was above, and this was very likely due to the fact that the canopy was not complete in places, the water being exposed to the sun; but it was still cool enough for brook trout.

Brook trout were found throughout this section, but they were mostly fingerlings. These occurred mostly on the riffles over gravel

or sand bottom. A few trout between five and six inches long were found in deeper pools. Very few other fishes were present and of these horn dace and sculpins predominated.

Just below this section the stream entered a fairly open area, an abandoned farm with some meadow but principally pastureland. A thick growth of willows and some blue beech comprised the principal trees, but there was in addition a tangle of golden-rod, virgin's bower, jewelweed, boneset, joe-pye weed and sedge grass on the north shore. In this section the stream was on the western side of the valley and very close to the base of the slope, which was fairly well wooded with typical second growth hardwoods (see Figs. 51 and 52).

Deep holes were common throughout this section which is about three-fourths of a mile long. Some of the holes were at least three feet deep. There were some more expansive areas of open water, a foot or more in depth and ten to twelve feet wide. Then toward the lower end of the section there were either pools alternating with riffles (as in figure 51), or stretches of shallow water over loose flat stones (as in figure 52). The water was still turbid.

I collected no trout in this section, yet some of the holes seemed well adapted to them. Well worn trails along the stream seemed to indicate that fishermen made frequent visits to some of these holes, yet I am convinced that if trout had been present even in small numbers I should have secured some with the net. Perhaps they had been fished out, or had migrated to the cooler and more favorable water of the upper sections. The temperature of 62° F here was, however, well below the maximum.

Black-nose dace, red-side shiner and horn dace were abundant in this section. Common shiners, stone rollers, sculpins, fantail and johnny darters, common suckers and hog suckers were found in rather small numbers. All were, however, more abundant than in the previous section.

The next section begins at the road bridge nearly three-fourths of a mile above the mouth of the stream and includes all of the remaining part except the last quarter mile. The entire section is wooded with the exception of a small area at the upper end, on the west side, where recent cutting has been done. A few hemlocks occur along the stream and add materially to the amount of shade furnished. Deep pools were also more common in this section and these would give more concealment for trout than would those in the other section, partly because the forest cover was better, and partly because many of them were either near overhanging banks or



Fig. 47. Upper section of Bone Run. The "Run" is well concealed by small willows and other plants. July 12, 1926.



Fig. 48. Main channel of Bone Run in an unused pasture just below mouth of Phillips Brook. Note the small trees scattered along the slope. July 15, 1926.





Fig. 49. Typical scene in the upper end of the North Branch of Bone Run. The small pools contained recently planted brook trout. July 15, 1926.



Fig. 50. Typical scene in the second growth hardwoods along the upper end of the North Branch of Bone Run. July 15, 1926.



near large boulders with sloping sides and deep fissures. As in the previous section, I found no trout, but there were large common suckers in the deep pools, as well as horn dace, black-nose dace and red-side shiners, stone rollers, fantail darters, common shiners and sculpins.

The last section lay in a pasture and open meadow, but heavily fringed with willows most of the way. The stream had cut a gorge through several feet of hardpan and here several deep pools occurred. The bottom was mostly hardpan covered with deposits of sand and fine gravel. The deposits have created riffles in places on which I found long-nose dace, rainbow darters, sculpins and johnny darters. Other species found in the previous section occurred here also but were more abundant. No trout were found.

The North Branch of Bone Run is "coming back" and will continue to improve rather rapidly if left undisturbed. There is very little land in the adjacent valley that is suitable for cultivation and much of this has already been abandoned and is reverting to forests. As a matter of fact there have never been many settlers here, and today there is but one house. It will be several years before the present stand of trees is mature and then we may expect another cutting, unless the ownership is transferred from private to public interests.

As stated in another section of this report, brook trout had been successfully planted in the headwaters just prior to my visit, and there were indications that a successful plant had been made the previous season. I believe that conditions are, however, far from the optimum at present, because the water very probably approaches, and possibly exceeds, the maximum temperature limit during August of each year. The great loss in planted fish can doubtless be attributed in part to this factor. But each year will doubtless see an improvement over the previous one. There were some excellent pools in certain parts of the Branch; but some of these were well downstream where the temperature would be intolerable for brook trout. A few pools below the fork were inhabited by brook trout other than those of the season's plant.

*Phillips Brook.* This tributary of Bone Run was studied throughout its entire length, on July 14 and 15. It has its headwaters rather close to the divide, near the small village of Vollandine, and flows southeastward through a very narrow valley to join the main stream about four miles distant. The Brook begins with small rivulets leading out of springs from the adjoining hillsides. There is really

no distinct channel here since the water is distributed throughout a bog-like area. The valley bottom is soft and mucky and supports a growth of cut-grass, cat-tails, jewelweed, wool grass, and similar vegetation; but very few trees. There was a sawmill at the headwaters and some of the forest in the immediate vicinity had been recently cut. The slopes bordering the brook were covered with a growth of sapling hardwoods. The water in the sulphur spring at the above mentioned sawmill registered  $59^{\circ}$  F; but some of the other spring rivulets had slightly colder water. The boggy condition of the stream continued for nearly a quarter of a mile. The stream then flowed through a wooded section for over three-quarters of a mile; but it was mostly out of sight under a bed of moss-covered rocks.

I saw a few small fishes, presumably black-nose dace, or horn dace, in the upper part of this section; but I could not secure them. I did, however, collect a black-nose dace in the extreme lower wooded part where the stream really began to take shape. Here I also found a newt (*Diemyctylus viridescens*). The rubble on the bottom of the brook at this place was well inhabited with damselfly and dragonfly nymphs and caddis fly larvae.

Following this section, the stream flows for nearly three-quarters of a mile through open territory. There was once a small settlement here; but at present the buildings, with one exception, are in ruins. The trees are fast encroaching on the abandoned fields and it will be only a matter of a few years, probably, before the entire area will be covered with forest. Figures 53 and 54 show typical scenes. The stream itself was bordered by small willows, golden-rod, buttercups, grasses and a variety of other weeds, which furnished considerable shade. There were pools at frequent intervals; but none of them would exceed two feet in depth nor six to eight feet in width.

Brook trout were found throughout this entire section, the first one being taken from the pool shown in the foreground of figure 53. Nearly every pool of suitable size contained one, two and sometimes more brook trout averaging approximately four inches in length. I saw none of legal size. Black-nose and horn dace were also collected here, the former being the more abundant.

The temperature of the water ( $54^{\circ}$ F) in this open area was four degrees colder than that at the sawmill near the headwaters. This would indicate that water somewhat colder than  $54^{\circ}$ F has been supplied by springs below the headwaters.



Fig. 51. North Branch of Bone Run just above second road bridge, to show pools and rapids that are characteristic of this section. July 12, 1926.



Fig. 52. Another section of the North Branch of Bone Run. A typical scene of the rapids above the second road bridge.





Fig. 53. Towards the headwaters of Phillips Brook which is the upper limit of brook trout. The surrounding area has been abandoned and is now being reforested. July 14, 1926.



Fig. 54. Another section of Phillips Brook showing a trout pool under the log and the type of the surrounding vegetation. July 14, 1926.



From this cleared section the stream entered a beautiful forest consisting of large hemlocks, some pine, beech, hard maple, birch and cherry. This particular part of the forest had evidently not been cut over for chemical wood. Figure 55 shows some of the larger trees near the stream. The undergrowth was not so dense in this forest as in the second growth stands; hence it had a more open appearance. The stream spreads out upon reaching the forested area and occupies a bed four to six feet wide, consisting of small flat rocks and gravel. There were no larger pools for trout and the water did not exceed 18 inches in depth at any point.

Brook trout fingerlings were found in relatively large numbers in the deeper parts of the brook, and frequently on the riffles as well. I believe that this part of the brook must have been planted with fish the past spring. An occasional horn dace, black-nose dace, or sculpin were the only associated fish species. Figure 55 represents a typical scene. Several trout were found in the little pools shown in the foreground.

Half a mile or more downstream the timber becomes smaller. The east bank of the stream especially is more open and was now grown up with grasses, golden-rod and some willows. The rocks in the streambed were covered with moss. Deeper pools occurred here; but those suitable for trout of legal size were very few. Some trout three or four inches in length were found where suitable pools occurred.

In the course of the next half mile of the stream, several very small clearings occurred and here the sedge grass grew very dense. The stream at these places was very narrow and frequently divided into two or more channels so as to be almost completely concealed. Some selective cuttings of hemlock in two small areas had opened the forest slightly. The water at the end of this section registered 56°F. Brook trout became noticeably scarcer in this last section, and the other species such as black-nose dace and horn dace increased slightly in numbers but were not at all common.

It was about a mile and a quarter from this part of the stream to Bone Run. For the first quarter mile of this distance the stream was in a well wooded area and contained three deep pools, none of which contained any trout. Large rocks were responsible for the presence of two of these pools. The bottom was composed of thin, shale-like rocks. The temperature of the water registered 56°F; consequently other fishes, especially the black-nose dace, were here more abundant.

Below this point the stream was more or less in open territory, but largely concealed by grasses and willows. Large rocks were common and aided in the formation of falls under which I found brook trout four to six inches in length. One or two were noticed in nearly every large pool of this kind. No fingerling trout were found here. Riffles caused by gravel deposits occurred between the pools, and on these as well as in the adjoining shallow water black-nose dace were rather abundant. The horn dace and red-side shiner were found in small numbers. Trails along the brook indicated that considerable fishing was being done in this part of it and it is quite possible that all the trout of legal size (and doubtless some of illegal size) had been taken. Signs indicated that the brook had been visited only a day or so prior to my work there.

The last quarter mile of the brook was in an area of pasture and meadowland. About the only trees along the stream were willows, and these mere shrubs. The bottom consisted mainly of gravel, sand and small stones, but there were large boulders in places and these helped to form deep pools. There were several such pools, and one just below the wooded area in the pasture contained the last specimen of brook trout I found in this brook. Figure 56 shows this pool and the pastured area beyond. There were a large number of black-nose dace, red-side shiners, horn dace and a few stone rollers in the same pool. The temperature of the water at the edge of the pasture was 62°F; but this went up to 68° before reaching Bone Run. Quantities of horn dace and black-nose dace were found on the gravel areas near the mouth of this brook. Johnny, fantail and rainbow darters were also present here. Blunt-nose minnow, straw-colored minnow, emerald minnow and common shiners were taken in the deeper pools.

Phillips Brook was better suited for trout in some respects than were any of the other streams in the tract. The water, until the middle of July at least, was cold enough for brook trout throughout nearly its entire length. The brook was well supplied with springs at the headwaters, and there was enough cover to maintain a fairly uniform temperature throughout much of its course.

Agriculture, although never practised extensively, has ceased to be profitable in this valley and the farmsteads were abandoned several years ago. The only signs of human activity consisted of a lumbering project at the very headwaters, and a small amount of selective cutting of hemlock which had been done on a small area well downstream. The forests are rapidly reclaiming the cleared areas and in a comparatively few years even the sites of the former farm-

steads will probably be obliterated by the growth of brush. A portion of the brook lay in a beautiful forested area, the best I found in the tract. Many of the trees were mature and will probably be cut within a few years.

It is rather unfortunate that there are very few deep pools in this brook, some long stretches having none at all. I believe that pools could be advantageously made at a few important places by means of dynamite, for I have seen dynamite used successfully to make deep drinking pools in stream bottoms for cattle. This could best be done during low water. It would not be necessary to plant the dynamite in the center of the stream for a hole at the margin would meet the same purpose.

**Pierce Run.** This stream (formerly called Pearse Run) has its source in the town of Randolph, slightly southeast of the village of Vollentine. It flows in a southeast direction to join the Allegheny River five miles distant. There is only one small tributary stream of Pierce Run and this was practically dry on July 17 when I visited it. I began my studies about one-half mile below the headwaters because there was not much water at the upper end. Here the stream was in an open settled region and flowed through cultivated fields and pastures, mostly the latter. My first observations were made opposite the Pine Hill School and the Run at this point lay in a used pasture. The stream was very narrow (scarcely two feet wide) and shallow but contained a good many fish, principally horn dace and black-nose dace. Their abundance was undoubtedly due to the fact that the water was rather warm ( $74^{\circ}\text{F}$ ), there being practically no protection from the sun. A few rods below the point where this temperature record was made the stream entered a small grove of hardwoods, and the temperature of the water dropped two degrees. Beyond the grove there was more open country, and in a short distance the temperature went up four degrees, or to  $76^{\circ}\text{F}$ , at the upper highway bridge. The section immediately below this bridge was in a pasture, and about one-eighth mile downstream it was wooded. The temperature of the stream, about six or eight rods beyond its entrance into the woods, was  $64^{\circ}\text{F}$ .

This variation in temperature indicated that there were rather frequent spring feeders on this Run, especially in the wooded sections. It seemed rather unusual that such fluctuations in temperature should occur in such short intervals; but of course the water was shallow and almost fully exposed to the sun's rays. The temperature readings were made in the late afternoon.

At the second highway bridge, which is a mile below the first one and a mile and a quarter from the point where I began observations, the temperature of the water was 68°F. Here again the stream flowed through an open area (an abandoned meadow) after leaving the woods.

The stream bed varied somewhat but in general consisted of mud, gravel and stones. There were many fossiliferous rocks in this section.

I found only three species of fish in this section: horn dace which were very abundant, black-nose dace which were common, and a few sculpins.

The three-quarter mile section below the second bridge was wooded with second growth hardwoods; but the canopy was rather incomplete except for a few small areas. There was a rank growth of sedge grass along the stream in the open areas. The stream was not over three feet wide in many places, and the current was slow. The stream bed was characterized by large loose stones with intervening gravel beds.

The temperature of the water at a point about a quarter mile below the bridge was 56°F, or 12 degrees colder than at the bridge. Here black-nose dace and horn dace were abundant, while red-side shiners and stone rollers made their first appearance. Some of the shallow pools in the open contained many small fry of black-nose dace and horn dace.

The next section, which is nearly three-quarters of a mile long, lies in a very narrow and rather deep valley. It differs from the previous section in that the stream itself is more in the open. There was a good stand of second growth hardwoods a few feet from either shore; but these were not close enough to furnish much shade. A certain amount of protection was, however, given the stream by small bordering willows and by dense growths of sedge grass. Figure 57 is a typical scene in the upper part of this section. For several rods the stream channel was close to the western slope and here were outcrops of thin layers of shale. The stream bed was composed of flat rock. There were a few deep pools, some that had been formed by waterfalls and others that were simply depressions under shelving rocks. In the areas where many tussocks of grass appeared the stream was frequently distributed into two or more channels, in which it was difficult to collect or to make satisfactory observations on the fish, for the stream was nearly completely concealed by the grass (see Fig. 58).





Fig. 55. The wooded section of Phillips Brook. Many fingerlings were found in the shallow pools such as are shown in the foreground. July 14, 1926.



Fig. 56. The lower section of Phillips Brook less than one quarter mile above Bone Run. The last trout was found in the pool near the large rock. July 14, 1926.

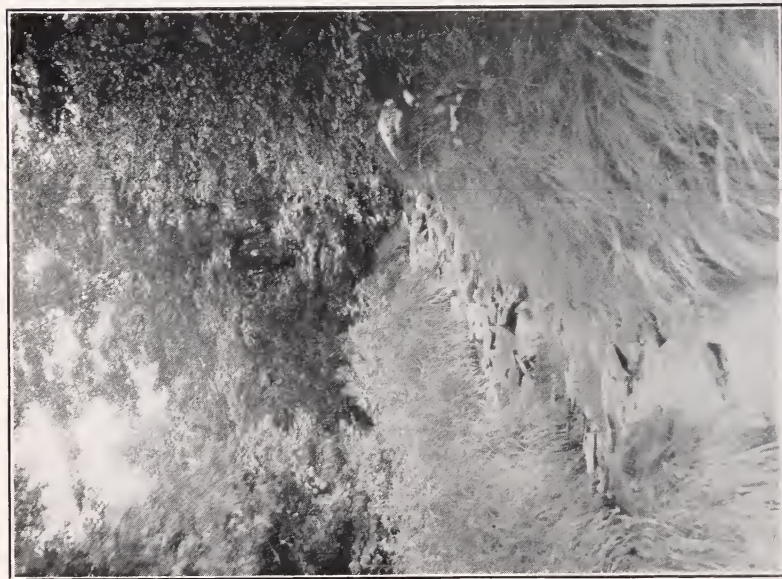


Fig. 57. Typical view of the upper end of the wooded section of Pierce Run. July 17, 1926.



Fig. 58. Pierce Run, toward the lower end of the wooded section to show the stream is concealed by grasses and weeds. July 17, 1926.

The stream bed became noticeably wider at the lower end of this section; but the total amount of water was probably not any greater than in the upper part of this or of the previous section. Large deposits of flat stones, boulders and gravel were conspicuous in many places, and some of these were several feet from the present channel, which indicated that a great volume of water passes through the valley in certain periods. Figure 59 shows the stream bed in the foreground and a large pile of deposited stones and gravel in the background. Occasionally the stream would practically disappear among these deposits of stones in the stream bed.

The temperature of the water gradually increased in this section from 60°F to 66°F and 68°F, and with this increase in temperature there came an increase in the number of fish. Horn dace, black-nose dace, red-side shiners, johnny darters, and *notropis dorsalis* were present in small numbers. Some horned dace were in spawning condition and their fry were found in the shallow sand or gravel-bottom pools.

The remainder of the stream (1½ miles) was almost entirely in open territory, a considerable part of which was pastureland. There are two large pastures bordering this section, extending to the Indian Reservation boundary which is about one-half mile from the river. These pastures were heavily stocked with cattle, and the grass had been cropped very short. There are no trees bordering the stream, so that the water is exposed directly to the sun's rays.

In the short distance of 8 or 10 rods through the pasture area I found that the water had increased in temperature from 68°F to 76°F.

There now followed a very marked difference in the character of the stream bed, as will be noted in figure 60. In addition to an increase in width, there appeared many more and larger stones and boulders. At frequent intervals were large piles of stones and gravel exposed by the receding water. Fishes were abundant, but confined to the pools or larger expanses of water. Some species were present in schools of considerable size.

Pierce Run is said to become nearly dry during periods of sub-normal rainfall. I found the greater part of it in poor condition to support brook trout. Unforested and heavily pastured areas at its headwaters as well as along its lower course have apparently been largely responsible for this condition. Judging from the various signs along the stream and from the reports of a few residents, the runoff from this valley is extremely rapid. The stream swells to great proportions within a short time after a heavy rainfall. Then,



too, due to the open character of the stream, the sun warms the water very quickly. These various factors more than offset the advantage of the copious supply of cold spring water. Although a small section of the stream contained deep pools with water of the proper temperature during early July, it is quite safe to predict that before the end of August the temperature would be too high for brook trout.

I would not advocate the planting of brook trout in Pierce Run until conditions are improved. The lower section is in a rather productive agricultural area and will probably not be abandoned for some time, if at all. This is also true of the extreme upper end. The middle section has been abandoned and the forest is now becoming reestablished.

**Hotchkiss Run.** This Run has its source in the Pine Hill region at an elevation of over 2000 feet. It is about five miles long, but about two-fifths of its lower section is within the Indian Reservation and thus outside the limits of the tract covered by this survey. Although Hotchkiss Run and Pierce Run are more than one and a half miles apart, at certain points, yet they enter the river within only a very few yards of each other. This is due to the fact that Hotchkiss Run upon entering the Reservation makes an abrupt turn from the southeast to the southwest. The upper section of the stream is in a plateau-like area which is being used for agricultural purposes. The land immediately surrounding it is mostly devoted to pastures, a small area having been cleared for that purpose within the past two years. Clearings of this nature, especially so close to the headwaters, have a very harmful effect on a stream as a trout habitat; probably much greater than similar clearings along its lower courses.

The temperature in the open area was 72°F. There were only a few small trout—perhaps one or two near legal size—and these were limited to the lower part of the open area; but the species increased in numbers toward the forest. Black-nose dace, horn dace and sculpins were present, but they too were limited in numbers, due evidently to an insufficient volume of water.

The next section, which was about one and a half miles long, was the only wooded part of the stream beyond the Indian Reservation. The trees here formed a good canopy over the stream. They were the usual second growth hardwoods of the region, in mixture with some hemlock and white pine. The stand along the stream contained larger trees at the upper end of the section than at the lower. Most of the trees were, however, under six inches in diameter.



The stream bed at the upper end of this section, in particular, consisted of large moss-covered stones and boulders. A long stretch of these at two different places served very effectively in bringing the water to a much lower level. At such places the water trickled over or through the rocks and formed small shallow pools on shelves, over a sand or gravel bottom, as shown in figures 61 and 62. The stream bed in the remaining section consisted of either moss-covered or bare rocks, with rather frequent shallow pools. Occasionally a small jam, formed by the lodging of logs and other débris among the rocks, was found, and the plunge basins below these were favorite places for trout. There were scarcely any deep pools but numerous shallow ones. The trout were able to find concealment under the loose stones or in the crevices of the solid rock formations.

The entire section was well stocked with brook trout, although the majority of them were of the fingerling size and probably belonged to last (1926) season's planting. The fingerlings in the upper part of the section were smaller and leaner than those in the lower section. Perhaps those in the upper waters were from natural reproduction and did not have the advantages of those reared at the hatcheries. In the stream were trout of sufficient size and presumably of sufficient age to have spawned at least once, and two specimens, each  $7\frac{1}{4}$  inches long, which I collected as samples, would have spawned that fall. Other collected specimens, under six inches, would very likely have spawned a year from that fall. Although I found no areas that seemed ideal or even very desirable for spawning beds, there were, nevertheless, some areas which the trout might accept in the absence of better ones.

A few horn dace, black-nose dace, pearly minnows (*Margariscus margarita*) and sculpins were associated with the trout in this section, especially at its lower end.

The temperature of the water in this wooded section varied from 64°F at the upper to 59°F at the lower end. This temperature was remarkably low considering the small volume of water, and indicates that the stream was spring fed at certain intervals. Judging from the sediment on the rocks, the water had lowered considerably within the last few days, and I feared that it might become too low for fish unless very soon raised again by rain.

There was a portable sawmill at the lower course of this section, and the logs were being secured from the eastern slope and ridge. Below this sawmill, in the next section, the country opened up, but the stream was densely bordered for some distance with low wil-

lows, virgin's bower, golden-rod, golden glow, and similar plants. The bottom was composed of many large and small stones, and deep pools occurred at frequent intervals. These pools for the distance of a few rods, contained trout of nearly legal size; but the temperature gradually increased until it reached 66°F, and here the last trout was found.

From this point to the Indian Reservation, a distance of nearly a mile, the stream flowed through pastures, meadows, or abandoned fields. Except in the pasture, there was some protection for the stream in the form of willows, weeds and grasses, but the channel was so much wider here than in the wooded area that this vegetation could not form a closed cover; consequently the temperature reached a maximum of 76°F in a relatively short distance.

Black-nose dace, horn dace, stone rollers, red-side shiners, suckers, darters and common shiners became very abundant throughout this section. There was an occasional deep pool and in such places the larger species, such as suckers and horn daces, congregated in great numbers.

The Indian Reservation section of the stream is partly wooded, but a considerable portion lies in an open area that is in a more or less wild state. A small stream entering from the western slope contained cold water, and this brought the temperature down to 72°F.

The upper half of this stream possessed many of the necessary requirements for brook trout, but the volume of water was rather inadequate. As stated above, brook trout were planted in this stream in June and seemed to be thriving fairly well up to the middle of July, when I worked there. There were also remnants of other plantings which included individuals well beyond the minimum legal size. The water was rather low, in fact, so low that the ultimate fate of the trout was in question. It is quite possible that enough water accumulates under the loose stones and boulders in the stream bed to tide the fish over periods of scanty rainfall. The larger trout, I noticed, were taking advantage of such places for concealment as I was collecting there. They were in the open pools before my arrival but on my approach hastily darted from one place to another in their efforts to find hiding places.

This section will probably be improved through natural reproduction, unless cutting continues; but the stream can hardly stand much further loss of its cover and still survive as a trout stream. It would be made a better stream by reforesting at its headwaters, where the land now is being pastured.



Fig. 59. View of Pierce Run to show the big pool in foreground and the large pile of rock deposits in background. July 17, 1926.



Fig. 60. Pierce Run a short distance below scene of Fig. 59, but in pastured area. The stream bed becomes wider here and the water much warmer. July 17, 1926.





Fig. 61. Hotchkiss Run looking upstream. A typical view in the upper wooded portion. Brook trout were found in the shallow pools and among the rocks. July 18, 1926.



Fig. 62. Another view of Hotchkiss Run which shows the character of the stream bed in the wooded area. July 17, 1926.



The lower half of the stream can hardly support trout unless a forest cover be provided, and this is not likely to be done so long as agriculture is still holding its own. I believe, however, the time will come when much of this valley will be abandoned, for the land is not especially productive.

## FOOD OF TROUT AND SOME OF THE ASSOCIATED SPECIES

In making studies of the streams of the Southwestern part of the Cattaraugus tract, considerable attention was given in the field to the amount of available food for fish life. Some of the larger forms of fish food, such as water striders, crayfish, beetles, stonefly and dragonfly nymphs, caddisfly larvae and the like were taken both in the net and in the hand. The best results were obtained by turning over rocks and sticks and by stirring up the sand and gravel. Caddisfly larvae and stonefly nymphs, as well as many other forms inhabiting the under side of rocks and other objects, were thus secured in numbers. The terrestrial insects were not considered except in a general way. Whenever possible I made note of the kinds and abundance of these. The low bushy growth and the grass along the streams ordinarily contained more insects than did the better forested areas. Grasshoppers, especially, were abundant in the open grassy sections along the streams.

Further knowledge of the food eaten was obtained by analysis of the stomach contents of the fishes collected. I examined all of the 49 brook trout taken and representatives of some of the other and more common species. A good many specimens contained little if any food. This was especially true of specimens that were in spawning condition.

The bulk of the food found in the digestive tract consisted of small organisms (mostly animal) that were quite inconspicuous in the stream and consequently escaped notice. The fish had apparently not availed themselves to any extent of the larger forms such as crayfish, stonefly nymphs, water striders and young fishes, all of which were either common or abundant. These were apparently too large.

Small beetles or their remains were found more frequently than anything else. Some of these were terrestrial and included weevils, bark beetles, ground beetles, etc. The chitinous nature of their elytra, which are not easily digested, no doubt accounts for the greater abundance of these among the fragments. Twenty-two of

the 49 trout in the collection had eaten a total of 38 beetles. The greatest number in any one fish was six.

Of the other fishes examined, twelve of the 39 red-side shiners (*Clinostomus clongatus*) had eaten a total of 24 beetles. Nine of the 27 horn dace (*Semotilus atromaculatus*) had eaten a total of 13 small beetles. An occasional beetle was found in the stomachs of the black-nose dace and common shiners.

Mosquitoes, which were very abundant in certain places in the tract, entered into the diet of the smaller fishes, to a certain extent. A total of 87, for example, were found in the stomachs of 11 of the 49 trout collected. The trout from Hotchkiss Run had evidently fed most abundantly on these insects, for one stomach contained 42, and another, half that number. Six of the 39 red-side shiners contained nine, and a horn dace contained but a single mosquito.

Small flies had also been eaten to a certain degree. Six brook trout contained one each and five horn dace contained one each. Another horn dace, 62 mm. long, from the lower part of Sawmill Run, had devoured a total of 65 black flies (*Simulium*). Thirteen red-side shiners had eaten a total of 17 flies.

Chironomid larvae and their tubes were found rather abundantly in certain streams, and 14 trout stomachs contained a total of 31 larvae, pupae or adults of such insects. Four red-side shiners contained a total of 16. A few chironomid larvae were found in the sculpins (*Cottus bairdii*). The common sucker (*Catostomus commersonii*) and black-nose dace also contained a few. One of the latter from State Line Brook had about fifty in its stomach.

Cases of certain caddisfly species were found on the lower edges of rocks in the streams while other species were found among the rubble on the bottom. The first kind was more common. The forms found in the stomachs of some of the fish were small, the cases having a material of leathery appearance. Six brook trout had taken a total of 10 of these, but one specimen from the North Branch of Bone Run contained five and three horn dace stomachs contained a total of five.

Small common suckers (*Catostomus commersonii*) seemed to have fed most extensively on caddisfly larvae, for I found a pure diet of these organisms in some of the specimens collected. I might say that these were all very minute forms of caddisflies, scarcely recognizable with the unaided eye, and the cases were constructed of fine particles of sand. One 120 mm. sucker from State Line Brook contained more than a hundred of these cases. Other specimens from Bone Run also contained large numbers. The common sucker

has teeth well adapted for crushing caddisfly cases, their effectiveness being evidenced by the amount of sand grains found in its digestive tract.

A few hymenopterous insects, principally ants, had been eaten. Seven brook trout had consumed a total of 10; and seven others had consumed a total of eight other small hymenopterans, principally parasitic species. Two horn dace had each taken one ant. Five others had each taken one other small hymenopteran, a *Tremex*, found in a fish from Hotchkiss Run. One red-side shiner from Phillips Brook contained two ants. Two others had each consumed a small hymenopteran.

Dragonfly nymphs were found in abundance in the upper waters of Phillips Brook, but only in moderate numbers elsewhere. There were few suitable habitats for them, except in the brook mentioned. Wings of adults were found in each of three trout and one nymph in each of two others. Also one horn dace and one red-side shiner contained one of these nymphs. Other insects found in the stomachs of these fishes in small numbers were scorpion flies, water mites, plant hoppers, grasshoppers, crane flies, mayfly nymphs, and water striders.

Millipedes, crawfish, spiders and snails were other invertebrates found in the stomachs of the fish. Of these, small spiders took first place in number.

Crawfish were not found in the stomachs of the trout, but two horn dace had taken one each. These crustaceans were abundant in certain sections of the streams, especially in the warmer waters. In the Allegheny River they fairly swarmed.

A rather limited amount of vegetable material was also found in the stomachs of the fish. The principal item was small seeds, apparently from sedge grass. The small trout had eaten more of this food than had the other species. One specimen contained 55 of the seeds and another, a dozen. The first of these two trout was taken in Phillips Brook, the other in the North Branch of Bone Run. Pieces of decayed wood and small leaves, probably taken accidentally with other food, were also found. The common shiner (*Notropis cornutus*) had eaten more green vegetable matter than had the other species of fish examined. Algae and small bits of leaves were found in several specimens. One specimen from Bone Run, 90 mm. long, had eaten a considerable amount of the leaf material.

It will be noted that only a small percentage of the invertebrates found in the stomachs of the fishes mentioned are strictly aquatic—a large proportion of them spend at least one stage of their life

history out of water. A number are strictly terrestrial. The streams in their present condition do not furnish a suitable habitat for some of the more desirable forms of insects which serve as food for young fish. They are practically devoid of aquatic plants of any kind, being subject to too great a variation in volume of water. During the summer in particular, but frequently after rains at other seasons, torrents of water rush down the valleys and dislodge and carry away not only the vegetation but much of the animal life harbored there as well. The water becomes very turbid during these floods. The streams subside very quickly after these floods, and unless replenished frequently by rains, soon become very low. The smaller tributary streams may become entirely dry during the summer and, in some instances, the main channel likewise. Bone Run and Pierce Run, for example, have been known to dry up in their lower courses during the summer months.

The drying up of even the smaller tributary streams has an appreciable effect upon the quantity and availability of fish food, not only in that it reduces the actual feeding range or "pasture" of the fish, but by the stoppage of transportation of such food to the permanently flowing streams where fish are found.

The inability of these streams to produce more potential fish food can be attributed to an important extent, to the deforestation of a large part of the watershed. Dr. Charles Reitell, of the Board of Commissioners of Pennsylvania, has recently published an article ('25) in which he places considerable emphasis on the amount of fish food as affected by droughts and floods. "By the cutting of our forests," he states (p. 260), "this live food supply has been greatly diminished. We have destroyed the gardens of our fish by eliminating the catch-basins for collecting the waters in the underground reservoirs. As a result, the springs and small brooks dry up, and we find that with this drought period comes death to plant life.

"This depletion of the 'great sponge' not only means death to the food of fish in drought periods, but likewise plays havoc in flood times. Muddy water carrying sediment in great quantities deposits it upon all forms of water vegetation, smothering and hampering its growth, while in excessive storm periods tremendous quantities of food-bearing vegetation, larvae, etc., are torn from their moorings and carried off.

"Light, by the way, also plays an important part in the growth and health of aquatic insect and plant life. Clear water will maintain a much more and better life than such roily, muddy waters that prevent the penetration of light."



## THE RELATION OF SOME FISH-EATING ANIMALS TO BROOK TROUT

A few years ago the Chemung County Rod and Gun Club at Elmira, N. Y., introduced a resolution at the annual convention of the New York State Fish, Game and Forest League, which had for its purpose the opening of the season on raccoon October 20 instead of November 10, in order that it might be hunted before it dens up for the winter. During the discussion, representatives of this club stated emphatically that the raccoon was largely responsible for the disappearance of the brook trout from some of the streams in Southern New York, and for this reason they desired a reduction in its numbers. The resolution was—and rightly, I believe—rejected. While charges of this sort sometimes arise in certain quarters, they are usually based on evidence, so-called, of the most flimsy and uncritical nature, and apparently have their source chiefly in prejudice. However, with this charge against the raccoon in mind, I made it a special point, during this survey, to get the testimony of local residents regarding this relation between the raccoon and the brook trout. A number of such residents when asked why, in their opinion, the trout were so scarce or why plantings were so unsuccessful, stated that the raccoon had “caught the trout off.” I found upon further questioning that they had no direct evidence for this charge, nor any tangible circumstantial evidence, but based their statements merely upon hearsay. Some thought that the presence of raccoon tracks in the mud along the streams was presumptive evidence that the animals were after fish. And there were, to be sure, raccoon tracks in the mud along some of the streams in this tract, but raccoons, as is well known, are quite partial to moist places and streams, because they find here various items on their bill of fare, other than fish. On several occasions I found the excrement of the raccoon on old logs, fallen trees, or other objects, and immediately recognized the bulk of the material as being the fruit of the service berry (*Amelanchier canadensis*). Some of the berries were quite entire, otherwise the seeds furnished the clearest evidence. I noticed a number of service berry shrubs along the streams, and these indicated doubtless the source of this fruit. The only animal material noted in the excrement was fragments of crawfish. During our work in the Allegany State Park in August, 1922, we also found considerable raccoon excrement, and this was composed largely of bird cherry fruit. Blackberries were also eaten to a certain extent.

Although the raccoon is generally believed to feed upon fish, I

believe that this is only an occasional occurrence in Southwestern New York, and that the fish concerned are principally the more sluggish kinds and not such active species as the trout.

Stone and Cram ('10, p. 250) state that "Fish is probably not a very steady article of diet with them [raccoons] at any season, for though good swimmers and not at all averse to entering the water, they lack both skill and the suppleness of the mink and otter which would enable them to plunge in boldly and seize their prey with their teeth.

"It is quite probable, however, that an occasional fish of the more sluggish species is hooked out by a stroke of the forepaw, especially if surprised in a shallow pool. But there seems to be no good evidence indicating that the raccoon is capable of catching fish of any kind to an extent that might affect the supply."

But another animal which came in for considerable blame, by local residents, for the scarcity of trout in the Cattaraugus tract, was the water snake (*Tropidonotus sipedon*). A farmer living near Steamburg attributed the unsuccessful attempts to stock the upper waters of Conewango Creek, to this snake. He stated that the planting of trout had ceased for that reason. Others were not so positive in their statements regarding these activities of the snake, but had a great dislike for it.

I saw a few snakes along most of the streams and especially at the highway bridges, but noted no unusual abundance. Ordinarily one or two, but sometimes more were found in their basking places. Occasionally one would be found among overhanging willows or other low shrubbery.

The stomachs of the two snakes that I secured for the collection were empty. I saw no really large specimens.

The water snakes, of course, do feed upon fish as well as frogs and toads, but I doubt if brook trout enter into their diet to any important extent. A stream that is suitable for brook trout is ordinarily too shady and too cool for the water snake, which likes warmth and on bright days spends a large portion of its time basking in the sun. I found one snake exploring the bottom of a brook rather cautiously and even though a number of minnows swam within easy reach, it made no attempt to capture any of them.

The mink is another possible enemy of the trout in these waters, but probably not a serious one. Although I saw no evidence of mink along the streams in the tract, they were reported as being fairly common.

Green herons and kingfishers were the only fish-eating birds noted in this section. I noticed the former particularly on Pierce Run where they were fishing in the pastured area in its lower course. Minnows, dace and suckers were common here, but there were no trout. It would, I believe, be unwise to molest the herons because they undoubtedly serve as a natural check on the fishes competing with the brook trout. Kingfishers were very common along the Allegheny River and some were noted along the lower stretches of the inlet streams. Their fishing is restricted largely to this river.

According to Johnson ('25, p. 247), the muskrat has also been credited with the habit of eating fish in some instances, although it ordinarily prefers a vegetable diet. Evidence of this animal was found along most of the streams, especially in the lower reaches where the water was warmer, deeper and less rapid than in the upper courses, and thus not in the trout frequented waters. In almost every case there was an abundance of minnows and other small fishes in the localities frequented by the muskrats, so that there would be no lack of fish food if the muskrat were a dexterous fish-catching animal, which it evidently is not.

## ARTIFICIAL STOCKING OF THE STREAMS AND ITS RELATION TO THE PRESENT CONDITION

**Records of Recent Plantings.** The records of trout planted in the streams considered in this report were furnished by the Conservation Commission through the courtesy of Mr. Sumner Cowden, Field Superintendent, and Mr. A. P. Miller, Superintendent of the Chautauqua Hatchery at Bemus Point. To avoid prejudicing the conclusions and to have a check on the reliability of seining in determining the fish population, I purposely waited until after the field work had been completed before securing these data.

My seining was done throughout the entire length of most of the streams but it was more thorough in the sections that seemed to be better trout habitats. Then, too, before using the seine at any pool, I carefully noted whether any trout could be seen. In the shallow pools, especially, the trout when disturbed will frequently dash from one place to another in their haste to find concealment under a rock, log or other object. With a little experience the trout can be distinguished from the associated species by these active, characteristic movements. Of course there were certain places where it was difficult to seine, but I feel that, in general, where trout were present even in relatively small numbers, representatives were either seen and recorded or collected.

The records of trout planting in these streams for the past five years show that both rainbow and steelhead trout, in addition to brook trout, have been planted in some of them. Steelhead trout were planted in Sawmill Run only, but rainbows were planted in Bone Run, Phillips Brook, Sawmill Run and Hotchkiss Run.

There was no evidence whatever of these two exotics in the streams last summer (1926) and it is quite likely that their existence was of only short duration. Inquiries from local residents indicated that few if any of these trout reached legal size.

According to the records of the Conservation Commission, for the last five years Sawmill Run has been planted more extensively with trout than have other streams of this territory. It is the largest stream. Besides brook trout, 1750 rainbow fry were planted there in 1922, 1000 in 1923, and 900 more in 1925. 1400 steelhead fry were planted instead of the rainbows in 1924. 1800 rainbow fry were likewise planted in Bone Run in 1922; 625 were planted in Phillips Brook in 1924, followed by 600 more in 1925; 1500 were planted in Hotchkiss Run in 1922. This makes a total of 8175 rainbows and 1400 steelheads. According to Mr. J. B. Swan, one of the leading sportsmen of Salamanca (in a letter to Mr. Witherell, dated December 10, 1926), 6000 rainbow fry were planted in Sawmill Run in 1923; and the following year, 4000 steelheads. It will be noted that these figures are considerably higher than those of the Conservation Commission and indicate that some fish were obtained from another source. Mr. Swan also states that Bone Run was stocked with six cans of rainbow fingerlings in 1921. Other records prior to 1922 will doubtless reveal that many more plantings of these two trout species have been made in these streams.

Sumner ('26, p. 13) states that "In order to secure the best results with Rainbow Trout they should be planted only in streams directly tributary to a cold lake or river where there are no impassable falls preventing the upstream migration of adults for the purpose of spawning.

"Rainbows ordinarily remain in smaller streams one year and occasionally two years after planting. They then migrate downstream and if a suitable habitat is not found, they disappear altogether. But if the stream flows directly into a lake or large deep river, this migration seems to be stopped. Becoming mature in the lake, the trout return to the streams during March and April to spawn after which they move downstream again to the lake. The lakes thus become the principal home of the larger fish while the streams are used for spawning purposes only."



In view of the above statements it is difficult to understand why rainbows were planted in these streams. The trout have access to the Allegheny River, to be sure, but this body of water is not a habitable one. The water is too warm, except perhaps in certain spring holes, and moreover, is polluted to such an extent that many of the fish succumb from its toxic effect. In all probability the young fish did not survive long enough in the small streams to reach the proper age or size prior to migrating to the river, and even should they have done so the chances are that they would soon have perished.

I learned that in 1926 no rainbows were planted in these streams. Evidently someone had discovered the uselessness of such planting. The cost of the "cut and try" system with regard to fish planting, needless to say, has been excessive and could have been avoided.

Brook trout have been more extensively planted in these waters than any other species, but in some instances with no better success. Even some of the plantings of last June were a total failure, unless it be that they escaped my seine completely. This has reference particularly to Sawmill Run and Pierce Run.

According to the records of the Conservation Commission, 13,900 brook trout were planted in Bone Run in the past five years as follows: 1922, 7600 number 1 fingerlings and 3000 number 3 fingerlings; 1924, 750 number 2½ fingerlings; 1925, 900 number 2½ fingerlings; 1926, 1050 number 3 fingerlings and 800 number 3½ fingerlings.

The only planting of brook trout in Phillips Brook during the past five years comprised 1200 number 3 fingerlings placed there last June (1926).

Brown's Run was planted in 1925 with 500 number 3½ brook trout fingerlings.

Hotchkiss Run and Pierce Run were each planted with 200 number 3½ fingerlings, last June (1926).

Sawmill Run was planted with 8450 fingerlings as follows: 1924, 2250 number 1 and 1250 number 2½ fingerlings; 1925, 2500 number 1, in addition to 400 number 3 fingerlings in each of the branches; 1926, 750 number 3 fingerlings, and 900 more in the South Branch.

**Present Status of Planted Fish.** As has been stated in the detailed description of these streams, remnants of these plantings and especially of the final one were found in some of the streams during July, 1926, but in general trout larger than fingerlings were scarce.

In the North Branch of Bone Run, and especially in the upper part, I found, on July 18, a good many fingerlings that no doubt constituted the survivors of the 1850 fingerlings planted on June 11 and 18, and July 10. They were in good condition and ranged from 65-75 mm. or more in length. Judging from the number I saw in the stream, I should say that they had suffered a considerable loss but were still sufficiently plentiful, considering the amount of water and available food. Perhaps those that I saw constituted principally the plant made 5 days prior to my visit. Larger specimens ranging up to  $5\frac{1}{2}$  inches in length were found above the middle section of the branch, and very likely represent the results of the 1924, 1925 and possibly earlier plantings. There is the possibility of a certain amount of natural reproduction having occurred, but this could hardly have been very great, for the breeding stock was very limited in numbers and small in size. Two of the larger trout in my collection would doubtless have spawned that fall (1926), and others showed promise of spawning a year from the coming fall (1927). I believe there were to be found areas that trout might have utilized for spawning beds although these were far from ideal.

The main part of Bone Run was too open, too warm and there were too many competitors for the available food to make it desirable for a brook trout habitat. If plantings had been made there, it is safe to say that the loss would have been complete.

The 1200 number 3 fingerlings planted in Phillips Brook on June 11 and 18, 1926, were found well distributed in the stream a considerable distance below the headwaters, in the more heavily forested area (see Fig. 55). The water was very shallow here, but the trout were taking advantage of the small pools below the riffles. Pools like those shown in figure 55 would each contain up to a half dozen fingerlings from 58-78 mm. in length. Examinations of their stomachs revealed that they had become accustomed to feeding on the natural food in the brook. I feel sure that a considerable percentage of the 1200 fingerlings had vanished, but the amount of food available in such a small volume of water would be scarcely sufficient for those that still remained. I dare say the decrease would have been more noticeable by the end of July.

Although there is no record of other plantings during the past five years, I found specimens over 4 inches long that were possibly the result of the 1925 planting. These might, however, have been naturally produced specimens or migrants from Bone Run. They

were found in the section immediately above the area planted in 1926, also quite near the mouth of the stream.

Phillips Brook was better suited for brook trout than were any of the other streams on the tract.

No brook trout were found in Brown's Run although 500 number 3½ fingerlings had been planted there in 1925. It is not a stream that I should select for planting purposes, even though a few short sections in the upper waters showed possibilities of supporting a few fish. With a considerable section of the upper part dry on July 9, the chances are that many of the apparently suitable stretches also would be either dry or too low for trout later in the summer. In the lower course of the brook the water is too warm and the competing species too numerous.

More attention has been given to Sawmill Run by way of stocking than to the other streams; but the results have been far from satisfactory. The main stream was much too warm for brook trout during the early part of July, but I saw one specimen in a deep hole under a highway bridge, that would have exceeded 6 inches in length. The quantities of other fish in this stream would offer strong competition to trout planted here. The North Branch near its upper end contained pools that were suitable, but I was unable to find any trout in them. The last survivors of the planting of 400 fingerlings, which was made in 1925, have apparently disappeared. Although the temperature on July 16 hovered around 68°, the maximum for trout, yet the spring feeders were said to prevent it from rising above that degree. With so much open territory, and pastureland in particular, I would expect the temperature to exceed this by several degrees, at least, during August; but it may be that the period of higher temperature is of short enough duration for the trout to survive. A farmer stated that "Austrians" fished this stream very persistently during the spring and early summer, and that most of the trout taken were under the legal size limit. Competing species, also, have undoubtedly been a factor in the failure of the plantings here.

I found no trace whatever of the 900 number 3 fingerlings that were planted on June 19, 1926, in the South Branch of Sawmill Run. The water in the upper part was cool enough for trout, but was inadequate in volume. A few pools above the sawmill contained enough water to support a number of trout, but I found only one specimen and that was over 5 inches long. There were large numbers of competing fish in these pools. If the planting was done below the sawmill, as I suspect it was, the temperature was too

high for their welfare and there were likewise too many other fishes competing for the available food.

The presence of any of the 200 number 3½ fingerlings that were planted in Pierce Run last spring (1926) could not be located though I seined rather thoroughly. This stream presented such a variation in conditions and especially in temperature that presumably the planting may have been improperly done. At any rate there was but a very limited area that would be at all suitable for brook trout.

Hotchkiss Run did not seem particularly favorable for brook trout; nevertheless, I found more here than in any of the other streams. The Conservation Commission records show that 200 number 3½ fingerlings were planted here in 1926, but I am sure that a greater number was to be found in the stream when I worked on it, July 17 and 18. These trout were very probably planted toward the end of June, or in early July, judging from the size of the stock, and if that be the case it may be assumed that no great loss had resulted in such a short time, provided the planting had been properly done. As mentioned elsewhere in this report there is also the possibility of natural reproduction from the larger specimens, and the fact that a smaller series of fingerlings were found well upstream would support such an assumption. Subtracting this smaller series from the total number I believe the result would fall a bit short of 200.

Although the records of the Conservation Commission show no other plantings of brook trout in this stream during the past five years, I found a representative series up to 7¼ inches in length. If no planting has been done, as stated above, then some of these must be the result of natural reproduction; or else they are migrants from other waters.

The Conservation Commission has no record of any planting in State Line Brook for the past five years, but it was learned from other sources that this stream has been stocked several times. There was only a small area that appeared at all favorable for brook trout, and the only specimen I found was living there.

In summing up the planting records of the past five years for these streams, we have a total of 25,650 brook trout, 8175 rainbow trout and 1400 steelhead trout.

Some of these planted fish have undoubtedly reached legal size and have been caught off, but just how many is of course difficult to determine. I was informed by local fishermen and others that a few trout have been caught, but that these did not greatly exceed



the minimum legal limit. With the exception of the one trout seen in Sawmill Run, Hotchkiss Run was the only stream containing trout of legal size, and their number was very limited. The larger trout of the other streams, if any existed, must have been caught off before July, and, incidentally, undersized fish had unquestionably been taken also. In any event, the ratio between the undersized trout and those of legal size is so great that it seems scarcely worthwhile for an angler to risk the lives of several of the smaller ones for each of the larger that he might hook. There are always a few unscrupulous or thoughtless anglers in a community who will not put back undersized fish, or if they do, will not take the proper precautions against fatal injury. I fear that some of these streams are fished by men of this character, a view which is strengthened by the testimony of persons whom I interviewed.

**Factors Responsible for Losses of Planted Fish.** The rapid disappearance of the fingerlings after planting is a matter of deep concern, and involves a great economic loss both in time and money that could have been expended to better advantage in making the streams more habitable.

In general, most of the season's plantings had been completed about one month prior to my visit; in some cases it was much less. As has been explained, the loss during this time in some of the streams was 100 per cent, granting that my observations were correct—with the exception of Hotchkiss Run, where the situation, as stated, was better. With the water gradually getting lower and warmer in the other streams it would seem that in another two months these would suffer a severe loss. Then, making further allowance for loss during the fall and winter months, it is difficult to understand how there might be any yearlings remaining by the spring of 1927.

This great loss is not peculiar to these waters, but is a common occurrence even in some of the supposedly better streams of the State. A certain amount of such loss is always to be expected and it is not uncommon to experience losses as high as 90 per cent and over, especially where fry are planted. The Biological Board of Canada, under the supervision of the Chairman, Dr. A. P. Knight, has conducted investigations during the past 3 or 4 years in Ontario to determine the loss of fry after distribution. The results of these investigations have been described briefly by White ('24) and by Knight ('25, '26 and '26A). Knight ('26A, p. 432) states that the loss of fry three months after planting during three successive

years, "ranged from 73 per cent to 100 per cent." The same author ('25, p. 590) states that "In seven streams and two ponds, a total of 97,500 fry or fingerlings were planted some in June of 1923 and some in June of 1924. In six of the streams the losses were apparently total at the end of three months. In streams and ponds combined, apparently only 1375 survived, being less than one and one-half per cent of the total fry planted."

The reasons for this high mortality is attributed (l. c., p. 591) to "(1) warm, stagnant, or peaty water; (2) enemy fish eating the fry, as shown by finding fry or fingerlings in their stomachs; and (3) lack of sufficient natural food."

The loss of planted fish in the Cattaraugus County streams can be partially attributed to two of the above factors. The water in some of the streams was too warm for brook trout, even in the headwaters. Then too, the large number of associated fish, being principally small species and living on essentially the same type of organisms, no doubt robbed the trout fingerlings of considerable food. Under ordinary conditions where food is abundant and where competition is lacking, it takes young trout several days to become accustomed to seeking their own food. The change from the food at the hatchery, which is handed out at regular intervals, to the more scanty and less easily accessible food in the streams—constituting the leavings of numerous other fish—is too sudden, I believe, for the success of the trout. In the sections of Hotchkiss Run, Bone Run and Phillips Brook occupied by the fingerling trout, there were practically no other fish; hence there was little competition for the food supply.

Losses resulting from predacious fish would probably be negligible in these waters. The horn dace (*Semotilus atromaculatus*) might account for some of the losses, and the older brook trout would very likely take additional toll, though I found no evidence of this in the stomachs of the specimens examined.

Knight stresses the value of eliminating enemy fish before attempting to plant trout fry, and cites the following specific example ('26A, p. 432): "One brook was partially seined of enemy fish and five thousand fry distributed in it. A second stream similar to the first was left unseined and five thousand deposited in it. At the end of three months both streams were seined and the survivors counted, with the result that fifteen hundred or 30 per cent were alive in the former and only 175 or 2 per cent in the latter." Mr. Albert French, Vice-president of the Mastigouche Fish and Game Club, of New York City, is quoted by Knight (l. c.) in regard to

the fishing areas of the Club near Montreal. Mr. French states that the Club was informed by "authorities in Washington that their trout failed to breed satisfactorily because the "lakes were out of 'balance'" due to the large number of suckers. To offset this unbalanced condition, 767,000 suckers were seined out. The desired results were said to have been attained in the case of at least one of the ponds.

It is true that there was an abundance of minnows and other similar species in some of the streams considered in this survey; but very probably they were there because the conditions were more favorable for them than for brook trout. Such fishes prefer and thrive in warmer water than the trout can endure; hence it is frequently a foregone conclusion that waters inhabited by large numbers of these minnows, chubs and suckers, etc., must be too warm for brook trout. Mr. A. G. Hamel, Forest Supervisor on the Superior National Forest, reports a loss of fully 95 per cent of young trout in some of the streams under his supervision. As there are no predatory fish in the waters planted he attributes the loss mainly to swift water, and to overcome this he is advocating the construction of rearing ponds.

## THE FUTURE POSSIBILITIES OF THE STREAMS

The future possibilities of these streams as trout producers depend to a large degree on whether the region remains in private ownership or is taken over by the public. It is certain that so long as the tract is privately owned there will be a large percentage of deforested land, as is the case at the present time; and as stated elsewhere in this report, this will mean a very uneven supply of water for the streams: torrents during the spring "break up" and after heavy rains, and inadequate, warm or stagnant water conditions during the summer months.

With the abandonment of many of the farms and their subsequent reversion to forest it is quite probable that some of the streams will show marked improvement, such as already exhibited by Phillips Brook and the North Branch of Bone Run. It seems reasonable, however, to predict that there will be other periods of intensive lumbering as soon as the existing second growth stands reach maturity. But this is looking ahead nearly half a century and in the interim I would expect the streams to undergo a great change for the better. The neighboring streams in the Allegany State Park show the effects of natural reforestation, especially in the upper

waters, but certain sections have been given a setback due to the inroads of man in making improvements to accommodate campers. The almost complete abandonment of the valleys after lumbering, except at their lower limits, has permitted the forests to develop a canopy overhanging the streams, so that the water is shaded and cool during the summer months.

If this Southwestern Cattaraugus County tract were to be acquired by the State, as it seems desirable that it should be, the forests would soon encroach on all the open fields much as they have already done in certain places. I would then strongly advocate the planting of considerable areas with conifers, because the natural reproduction would be principally hardwoods, and coniferous forests are more effective in checking the runoff. There is, furthermore, a slower decomposition of the litter and duff in a coniferous than in a hardwood forest; and in addition the melting of the snow and the evaporation of moisture is much slower.

The polluted condition of the Allegheny River seems to impose a great handicap on the tributary trout streams. Were it not for this, the larger trout could seek refuge in the colder spring holes, at certain seasons, as they have undoubtedly done in the past, prior to the pollution. Now, however, the water in the river outside of the spring holes becomes too warm for trout during the summer months. I suspect that the tributary streams formerly served more or less in the capacity of nursery streams for the river.

The accessibility of these streams has, no doubt, been a very important factor in the depletion of trout. They are so easily reached by roads that unless restrictive measures are imposed I fear the trout will never have an opportunity to become plentiful, even if conditions otherwise should become more favorable. Although the fishing is not good enough at present to attract many anglers, yet one can be assured that the anglers will increase in direct ratio to any increase in trout. Theoretically, therefore, this means that there can be no natural reproduction of any quantitative significance and that planting must be made a perpetual measure. But a true sportsman ordinarily does not care for such mild fishing. He prefers to seek out the more remote and wilder localities that may have escaped such a riffraff of fishermen as ordinarily are said to visit the streams of this tract.

When it comes to planting, however, it must be admitted that it is a decided advantage to have the streams accessible by automobile. The planting crew is then more likely to reach the proper planting places than they would be if they had to go afoot; moreover, the



stock to be planted is not so long enroute, and with the better facilities for taking care of them in the automobiles the fish would reach their destination in much better condition.

These streams like many others that have been tampered with by man either directly or indirectly, are apparently out of balance. They are out of balance because certain organisms or groups of organisms have increased to an abnormal degree at the expense of some other organisms, due to some interference with nature's program. The elimination of predacious fish, including adult brook trout, and the decrease in the number of fish-eating birds, reptiles and mammals, which are natural enemies of minnows, dace, suckers, etc., has made it possible for these last named fishes to become dominant in the streams. This dominance has a direct and vital effect on the brook trout. The fishes concerned seek out the minute or semi-microscopic organisms that are essentially the food of young trout. The struggle is thus quite one-sided and in favor of the minnows. Furthermore every adult brook trout that is removed from the stream means the loss of a potential enemy of the minnows. Any decrease in the number of minnows would theoretically mean more food for young trout. The young trout are handicapped especially when first planted in that they are unaccustomed to seeking their own food, and this handicap takes on more significance when we consider that the other competing fishes (minnows) are actively availing themselves of the more easily obtained food organisms. This may be one of the chief reasons why young trout suffer such a heavy loss when first planted.

The unbalanced condition of our streams, resulting from the destruction of the natural enemies of fish by man, has been well described by Dr. W. C. Kendall, '24, p. 279, as follows:

"The normal enemies of any fish, under natural conditions in a given body of water, have probably existed in normal numbers until civilization interfered with natural conditions. These so-called enemies are nature's balance wheels and it is only when normal conditions are disturbed that those enemies of any fish become generally harmful to it. Man has been the most destructive enemy of fish in general. He has tampered with nature's machinery and thrown it out of balance. The results have not always been correctly attributed to him, but rather laid at the door of some of the alleged natural enemies.

"Man's interference may have increased the number of some enemies and diminished the number of others. Some one natural enemy of a given fish may prey upon other fishes as objects of his

'enmity.' Some of the latter may also be enemies of the first mentioned fish; sometimes direct enemies, that is, preying directly upon the fish, or competitors for the food supply, or both. In the latter case their injurious effects would be doubled. So if man should destroy the first mentioned enemy which serves as a check to the undue increase of the others the effect of an over-production of the latter might be worse than before."

## RECOMMENDATIONS

The following recommendations for the improvement of the streams of this tract as trout habitats are made rather reservedly, for, in general, they cannot be effectively carried out while the land is privately owned. While the landowners may cooperate with the sportsmen to a certain extent it is doubtful if some of the greater changes, such as reforestation, can be satisfactorily accomplished in that manner. It requires many years to make changes of this sort and it would be useless to make any great outlay in time and money unless it be reasonably assured that the results would be of the lasting sort.

1. Provide a better forest cover for the streams, especially at the lower extremities. Such quick growing species as willow and speckled alder not only form good cover but very effectively check erosion.

2. Endeavor to establish a forest similar to the original stand on the abandoned areas. To do this, white pine and hemlock should be planted, with wide spacing. The hardwoods will naturally fill in the intervening areas. This type of forest is necessary to insure a more even supply of water for the streams.

3. Prevent pollution of the Allegheny River.

4. A few sticks of dynamite used at well chosen sites in some trout streams would provide pools in sections where they are lacking.

5. Close the streams for a few years at least and thus allow the brook trout to become sufficiently established to compete with the associated species of fish.

6. Better protection should be provided to prevent the illegal taking of trout.

7. It would seem unwise to plant any species other than brook trout, and nothing smaller than large fingerlings—the larger the better—should be used.

8. All plantings should be done well upstream at well chosen points.

9. The habit of shooting fish-eating birds should be discouraged.

These are important in keeping the minnows, dace, suckers, etc., in check.

10. Pasturing or lumbering of areas adjacent to the streams is very detrimental to brook trout waters, but it is difficult to prevent these activities under private ownership. Therefore,

11. If streams on areas like the tract in question are to be perpetuated and rendered habitable to brook trout, the only effective solution, probably, is the acquisition of such areas by the State.

### LIST OF FISHES FOUND IN THE STREAMS \*

1. Common Sucker	<i>Catostomus commersonii</i> (Lacépède)
2. Hog Sucker	<i>Hypentelium nigricans</i> (Le Sueur)
3. Stone Roller	<i>Camptostoma anomalum</i> (Rafinesque)
4. Blunt-nose Minnow	<i>Pimephales notatus</i> (Rafinesque)
5. Cut-lip Minnow	<i>Exoglossum maxillingua</i> (Le Sueur)
6. Common Shiner	<i>Notropis cornutus</i> (Mitchill)
7. Straw-colored Minnow	<i>Notropis deliciosus</i> Girard
8. ....	<i>Notropis volucellus volucellus</i> (Cope)
9. Gilberts Minnow	<i>Notropis dorsalis</i> (Agassiz)
10. Long-nose Dace	<i>Rhinichthys cataractae</i> (Cuvier and Valenciennes)
11. Black-nose Dace	<i>Rhinichthys atronasus</i> (Mitchill)
12. Horn Dace	<i>Semotilus atromaculatus</i> (Mitchill)
13. Red-side Shiner	<i>Clinostomus elongatus</i> Girard
14. Pearly Minnow	<i>Margariscus margarita</i> Cope
15. Brook Trout	<i>Salvelinus fontinalis</i> (Mitchill)
16. Trout Perch	<i>Percopsis omisco-maycus</i> Walbaum
17. Johnny Darter	<i>Boleosoma nigrum</i> (Rafinesque)
18. Green-side Darter	<i>Etheostoma blennioides</i> Rafinesque
19. Black-side Darter	<i>Hadropterus aspro</i> (Jordan)
20. Fantail Darter	<i>Catnotus flabellaris</i> Rafinesque
21. Rainbow Darter	<i>Poecilichthys coeruleus</i> Storer
22. Sculpin	<i>Cottus bairdii</i> Girard

### BIBLIOGRAPHY

- BATES, CARLOS G.  
1921. How Willows Stop Erosion. Amer. Forests and Forest Life Mag., Vol. 31, pp. 259-262.
- COWDEN, SUMNER M.  
1926. Proper Methods of Planting Fish. 15th Ann. Rept. N. Y. State Conservation Commission, for 1925 (1926), pp. 73-86 (also reprint).

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FASTEN, NATHAN

1927. The Need of Game Fishery Investigations. *Sci. Monthly*, Vol. 24, pp. 81-83.

FRANCIS, H. R.

1922. The Recreational Resources of the Allegany State Park. First Ann. Rept. of the Commissioners of the Allegany State Park. Appen. C, pp. 49-86. Albany.

JOHNSON, CHARLES E.

1925. The Muskrat in New York; Its Natural History and Economics. *Roosevelt Wild Life Bulletin*, Vol. 3, No. 2, pp. 205-320.

KENDALL, W. C.

1924. The Status of Fish Culture in our Inland Public Waters, and the Role of Investigation in the Maintenance of Fish Resources. *Roosevelt Wild Life Bulletin*, Vol. 2, No. 3, pp. 205-351.

KENADLL, W. C. and DENCE, W. A.

1927. A Trout Survey of the Allegany State Park, New York. *Roosevelt Wild Life Bulletin*, Vol. 4, No. 3, pp. 291-484.

KNIGHT, A. P.

1925. The Losses of Trout Fry after Distribution. *Science*, N. S., Vol. 62, pp. 500-591.  
1926. Losses of Trout Fry after Distribution. *Science*, N. S., Vol. 63, pp. 209-210.  
1926a. The Losses of Trout Fry after Distribution. *Science*, N. S., Vol. 64, p. 432.

MACDONALD ALEXANDER

1926. Fish Distribution (Waters in New York State Stocked in 1925 by the Conservation Commission). Pp. 1-59. Albany.

REITELL, CHARLES

1925. More Forests.—Better Fishing. *Amer. Forests and Forest Life Mag.*, Vol. 31, pp. 259-262, 296.

STONE, WITMER and CRAMM, W. E.

1910. *American Animals*. Pp. 247-254. New York.

WHITE, H. C.

1924. A Quantitative Determination of the Number of Survivors from Planting 5000 Trout Fry in each of two streams. *Contrib. to Canadian Biology*. *Biol. Station of Canada*, Vol. 2, pp. 137-152.



## THE ROOSEVELT WILD LIFE MEMORIAL

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The State of New York is the trustee of this wild life Memorial to Theodore Roosevelt. The New York State College of Forestry at Syracuse is a State institution supported solely by State funds, and the Roosevelt Wild Life Forest Experiment Station is a part of this institution. The Trustees are State officials. A legislative mandate instructed them as follows:

"To establish and conduct an experimental station to be known as 'Roosevelt Wild Life Forest Experiment Station,' in which there shall be maintained records of the results of the experiments and investigations made and research work accomplished; also a library of works, publications, papers and data having to do with wild life, together with means for practical illustration and demonstration, which library shall, at all reasonable hours, be open to the public." [Laws of New York, chapter 536. Became a law May 10, 1919.]

### As a General Memorial

While this Memorial Station was founded by New York State, its functions are not limited solely to the State. The Trustees are further authorized to cooperate with other agencies, so that the work is by no means limited to the boundaries of the State or by State funds. Provision for this has been made by the law as follows:

"To enter into any contract necessary or appropriate for carrying out any of the purposes or objects of the College, including such as shall involve cooperation with any person, corporation or association or any department of the government of the State of New York or of the United States in laboratory, experimental, investigative or research work, and the acceptance from such person, corporation, association, or department of the State or Federal government of gifts or contributions of money, expert service, labor, materials, apparatus, appliances or other property in connection therewith." [Laws of New York, chapter 42. Became a law March 7, 1918.]

By these laws the Empire State has made provision to conduct forest wild life research upon a comprehensive basis, and on a plan as broad as that approved by Theodore Roosevelt himself.

### Form of Bequest to the Roosevelt Wild Life Memorial

I hereby give and bequeath to the Roosevelt Wild Life Forest Experiment Station of The New York State College of Forestry at Syracuse, for wild life research, library, and for publication, the sum of ..... or the following books, lands, etc.

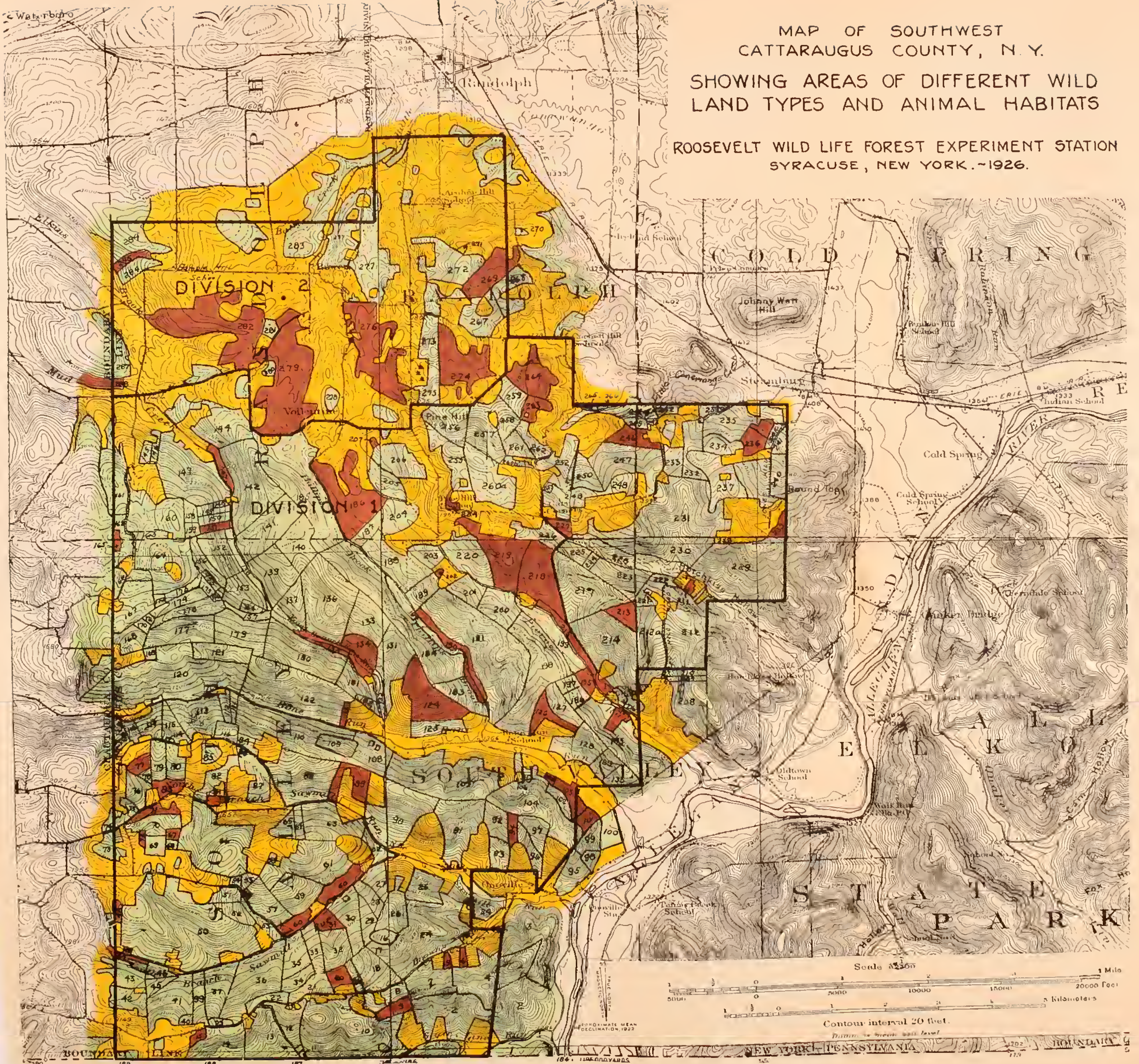




# MAP OF SOUTHWEST CATTARAUGUS COUNTY, N. Y.

SHOWING AREAS OF DIFFERENT WILD  
LAND TYPES AND ANIMAL HABITATS

ROOSEVELT WILD LIFE FOREST EXPERIMENT STATION  
SYRACUSE, NEW YORK. -1926.

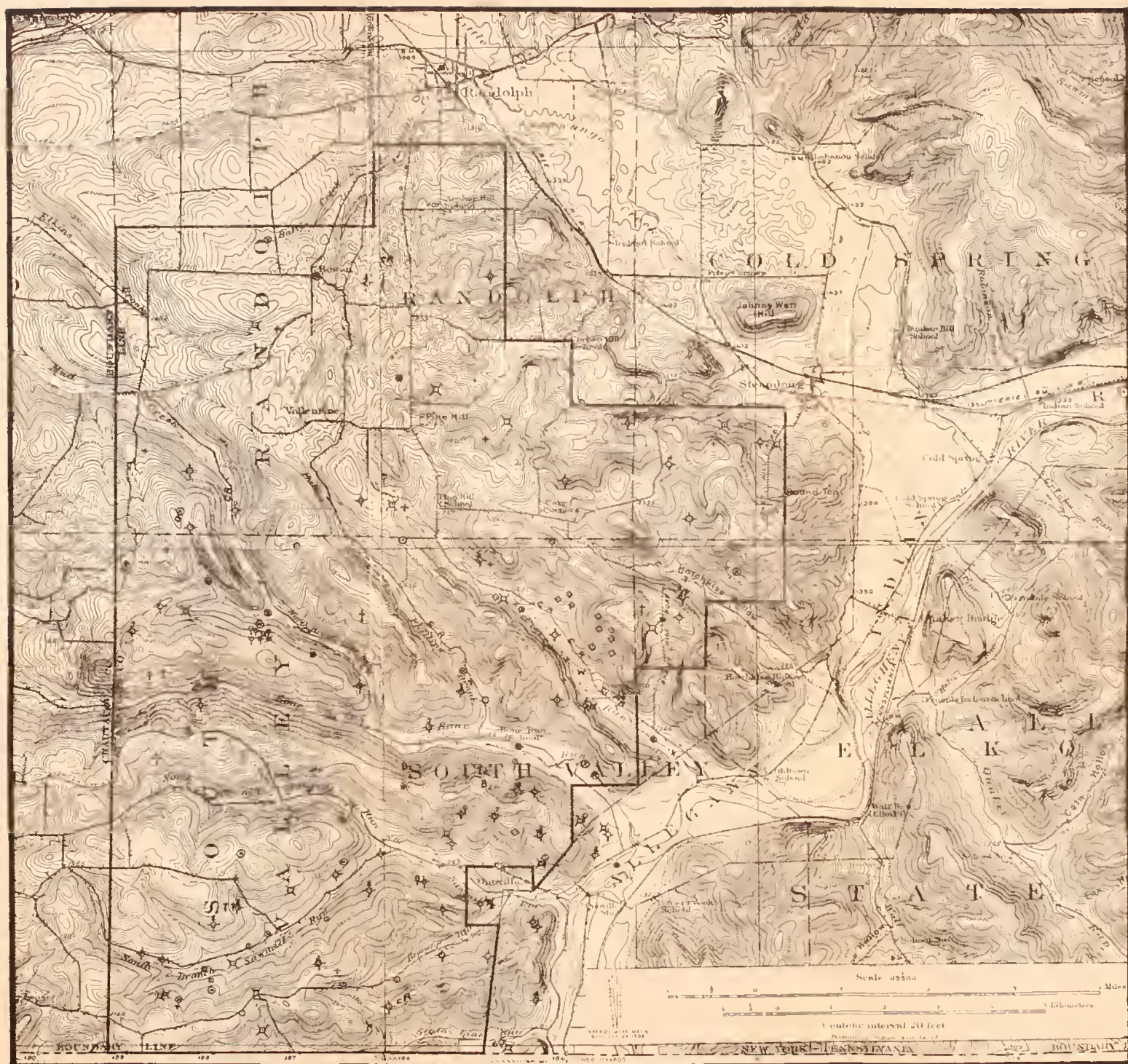


Map 2. Map of Southwest Cattaraugus county, N. Y., showing areas of different wild land types and forest habitats.









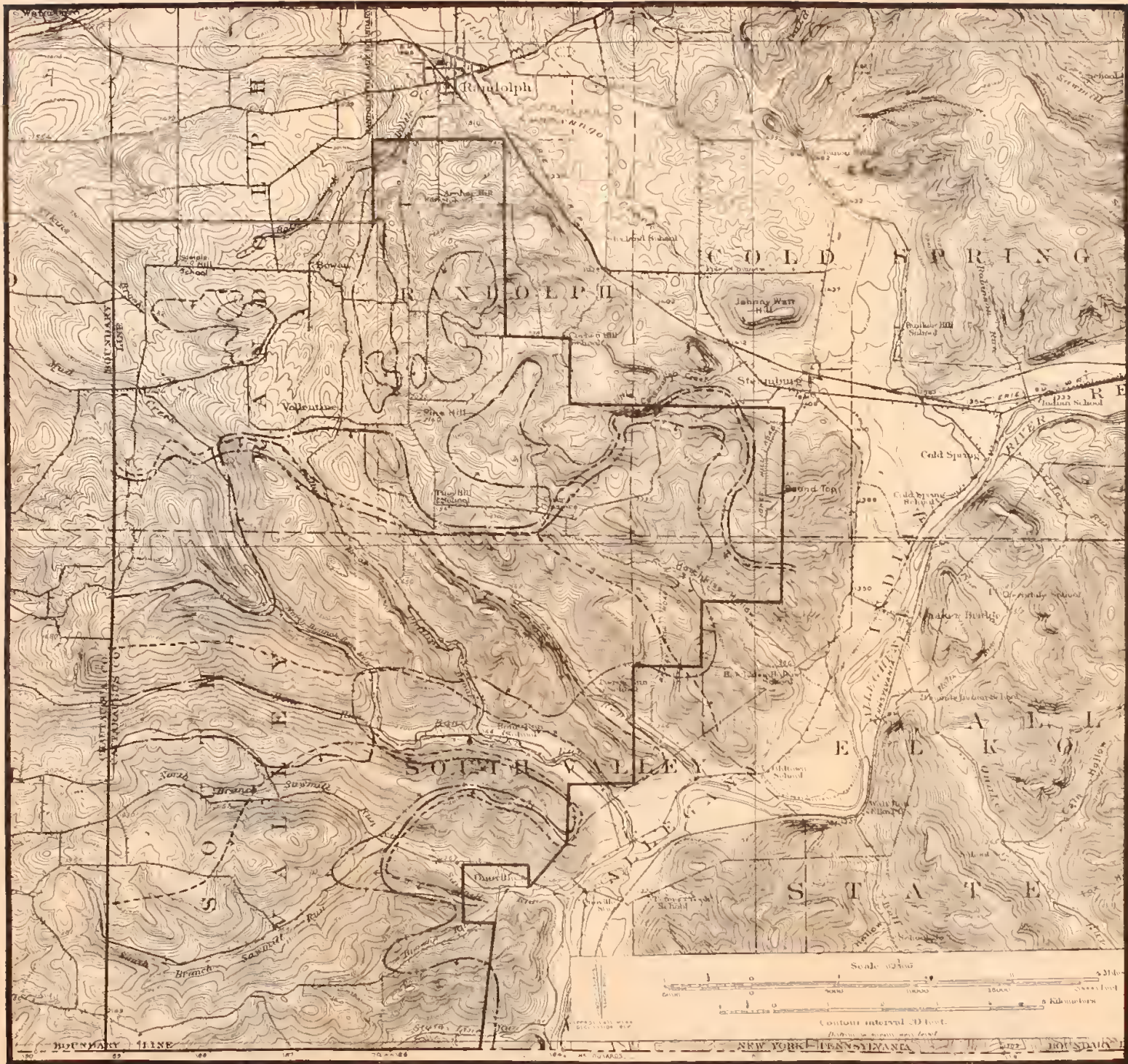
Map 3. Showing occurrence of important species of mammals and Game birds according to actual observations during the Summer of 1926.

(Symbols indicate the locality where the various animals or their fresh sign were seen.)

- |             |                     |  |
|-------------|---------------------|--|
| + = Raccoon | ○ = Red Squirrel    | ⊕ = Ruffed Grouse                          |
| ⊕ = Muskrat | ⌘ = Gray Squirrel   | B = Black Bear                             |
| * = Fox     | ⊖ = Porcupine       | w = Woodcock                               |
| † = Skunk   | ◇ = Snowshoe Rabbit | CR = Cottontail Rabbit (notable abundance) |





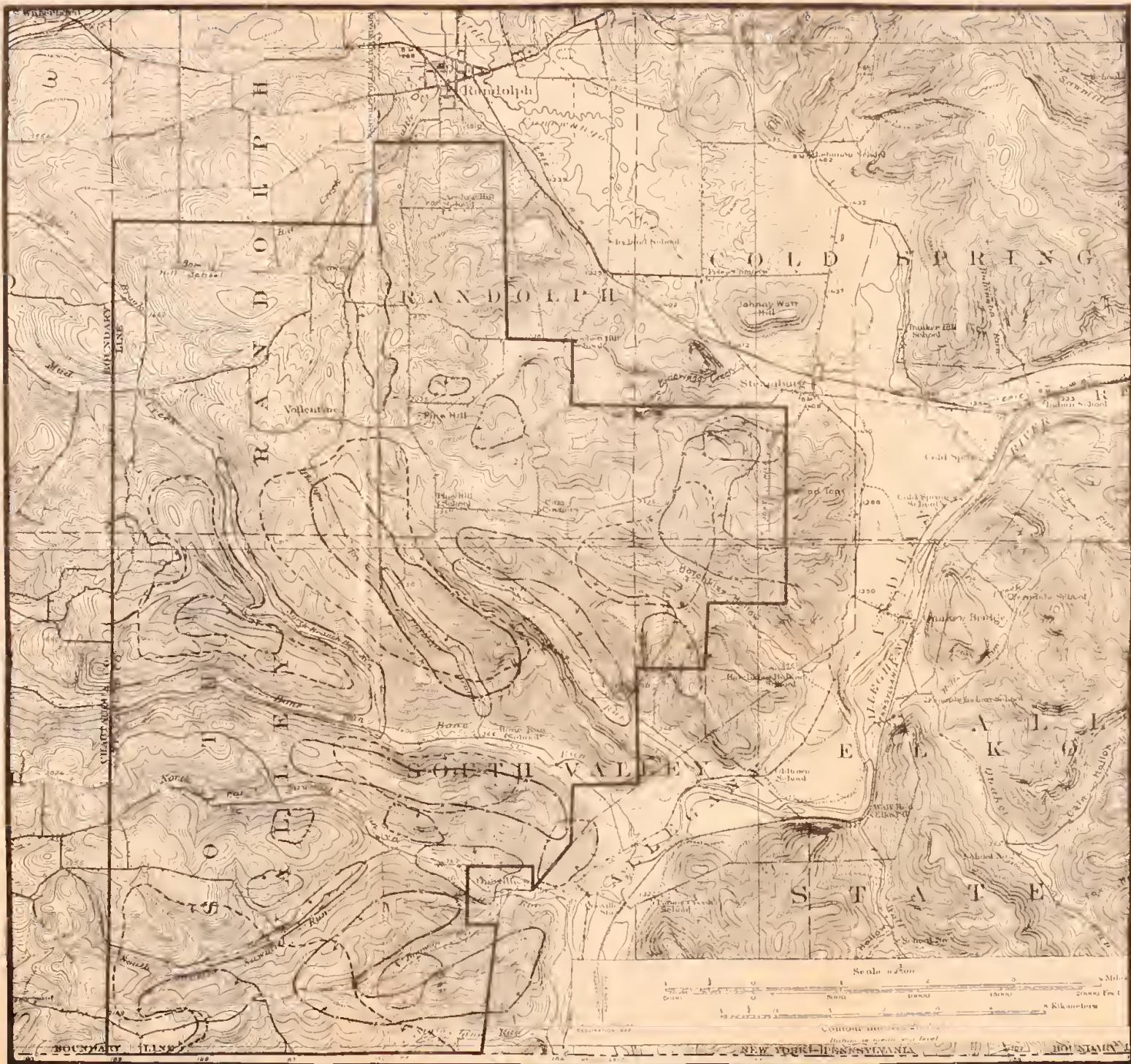


Map 4 Range map of Raccoon, Muskrat, Red Fox and Deer based on information given by residents and on actual observations in the Summer of 1926

- Raccoon
- x—x— Muskrat
- Red Fox
- +--+ Deer (based only on testimony)







Map 5 Range map of Black Bear, Snowshoe Rabbit, Cottontail Rabbit and Gray Squirrel based on information given by residents and on actual observation during the Summer of 1926

- • Black Bear
- x-x- Snowshoe Rabbit
- ..... • Cottontail Rabbit (notable abundance)
- +-+ Gray Squirrel







Map 6 Range map of Game birds based on information given by residents and on actual observations during the Summer of 1926.

- Ruffed Grouse (greatest abundance)
- x-x- Woodcock (in migratory season)
- Pheasant





ROOSEVELT WILD LIFE BULLETIN, Vol. 2, No. 1. October, 1923.

1. The Control of Blood-sucking Leeches, with an Account of the Leeches of Palisades Interstate Park.....Dr. J. Percy Moore.
2. Preliminary Report on the Parasitic Worms of Oneida Lake, New York.....Dr. Henry S. Pratt
3. Acanthocephala from the Fishes of Oneida Lake, New York.....Dr. Harley J. Van Cleave.
4. Current Station Notes.....The Director and Editor.

ROOSEVELT WILD LIFE BULLETIN, Vol. 2, No. 2. February, 1924.

1. Ecology of the Plankton Algae in the Palisades Interstate Park, Including the Relation of Control Methods to Fish Culture.....Dr. Gilbert M. Smith.

ROOSEVELT WILD LIFE BULLETIN, Vol. 2, No. 3. March, 1924.

1. The Status of Fish Culture in Our Inland Public Waters, and the Role of Investigation in the Maintenance of Fish Resources.....Dr. William C. Kendall.
2. Current Station Notes.....The Director and Editor.

ROOSEVELT WILD LIFE BULLETIN, Vol. 2, No. 4. February, 1925.

1. The Relation of Wild Life to the Public in National and State Parks.....Dr. Charles C. Adams.
2. The Big Game Animals of Yellowstone National Park..Edmund Heller.
3. The Food of Trout in Yellowstone National Park.....Dr. Richard A. Muttkowski.
4. Current Station Notes.....The Director and Editor.

ROOSEVELT WILD LIFE BULLETIN, Vol. 3, No. 1. February, 1925.

1. The Birds of the Yellowstone National Park....Milton P. Skinner.
2. Current Station Notes.....The Director and Editor.

ROOSEVELT WILD LIFE BULLETIN, Vol. 3, No. 2. March, 1925.

1. The Muskrat in New York: Its Natural History and Economics....Dr. Charles E. Johnson.
2. Current Station Notes.....The Director and Editor.

ROOSEVELT WILD LIFE BULLETIN, Vol. 3, No. 3. September, 1926.

1. The Summer Birds of Central New York Marshes.Aretas A. Saunders.
2. Additional Notes on the Summer Birds of Allegany State Park.....Aretas A. Saunders.
3. Current Station Notes.....The Director and Editor.

ROOSEVELT WILD LIFE BULLETIN, Vol. 3, No. 4. October, 1926.

1. The Economic and Social Importance of Animals in Forestry, with Special Reference to Wild Life.....Charles C. Adams.
2. The Land-Economic Survey in Michigan.....R. A. Smith.
3. Current Station Notes.....Charles C. Adams.

ROOSEVELT WILD LIFE BULLETIN, Vol. 4, No. 1. October, 1926.

1. The Relation of Birds to Woodlots in New York State.....Waldo L. McAtee.
2. Current Station Notes.....Charles C. Adams.

ROOSEVELT WILD LIFE BULLETIN, Vol. 4, No. 2. June, 1927.

1. The Predatory and Fur-bearing Animals of the Yellowstone National Park .....Milton P. Skinner.
2. Current Station Notes.....Charles C. Adams.

ROOSEVELT WILD LIFE BULLETIN, Vol. 4, No. 3. July, 1927.

1. A Trout Survey of Allegany State Park in 1922.....William C. Kendall and Wilford A. Dence.
2. A Preliminary Survey of the Fish Life of Allegany State Park in 1921 .....Thomas L. Hankinson.
3. Current Station Notes.....Charles C. Adams.

ROOSEVELT WILD LIFE BULLETIN, Vol. 4, No. 4. July, 1927.

1. The Beaver in the Adirondacks: Its Economics and Natural History...Charles E. Johnson.

